

DRAFT
SEDIMENT SAMPLING REPORT FOR
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Prepared for

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CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION	1
2.0 PROJECT BACKGROUND	2
2.1 SITE BACKGROUND AND SETTING.....	2
2.2 SUMMARY OF PREVIOUS INVESTIGATIONS	3
2.3 SAMPLING OBJECTIVES	5
3.0 FIELD SURVEY AND SAMPLING ACTIVITIES	7
3.1 WATER DEPTH AND SEDIMENT THICKNESS SURVEY	7
3.2 SEDIMENT SAMPLING LOCATIONS AND POSITIONING	8
3.3 SEDIMENT SAMPLING METHODS.....	8
3.4 QUALITY CONTROL SAMPLING	9
4.0 SEDIMENT SAMPLE RESULTS	10
4.1 SAMPLE RESULTS FOR DUCK CREEK	10
4.1.1 Pesticides	10
4.1.2 PCBs	11
4.1.3 PAHs.....	11
4.1.4 Metals	13
4.1.5 Toxicity.....	14
4.1.6 Miscellaneous Parameters.....	15
4.2 SAMPLE RESULTS FOR OTTER CREEK.....	15
4.2.1 Pesticides	15
4.2.2 PCBs	16
4.2.3 PAHs.....	16
4.2.4 Metals	18
4.2.5 Toxicity.....	18
4.2.6 Miscellaneous	19
4.3 SUMMARY OF SAMPLE RESULTS	20
5.0 QUALITY CONTROL EVALUATION OF DATA.....	22
6.0 CONCLUSIONS AND RECOMMENDATIONS	23
REFERENCES	25

TABLES

<u>Table</u>	<u>Page</u>
1 SUMMARY OF TOXICITY TESTING - DUCK CREEK.....	14
2 SUMMARY OF TOXICITY TESTING - OTTER CREEK	19

CONTENTS (Continued)

Appendices

A FIGURES

- A-1 SEDIMENT SAMPLING AND PROBING LOCATIONS APRIL 2007
- A-2 DOWNSTREAM SEDIMENT SAMPLE ANALYTICAL RESULTS APRIL 2007
- A-3 UPSTREAM SEDIMENT SAMPLE ANALYTICAL RESULTS APRIL 2007

B TABLES

- B-1 SEDIMENT SAMPLE LOCATION COORDINATES
- B-2 SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
- B-3 SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
- B-4 SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
- B-5 SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL & GREASE
- B-6 SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - FULL-SCAN PAHs
- B-7 SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - AVS/SEM
- B-8 SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS

C DATA VALIDATION REPORTS

D DUCK AND OTTER CREEKS SEDIMENT TOXICITY TESTING

E SEDIMENT VOLUME SUMMARY

1.0 INTRODUCTION

SulTRAC prepared this Duck and Otter Creeks sediment sampling report for the U.S. Environmental Protection Agency (EPA) Great Lakes National Program Office (GLNPO) under EPA Remedial Action Contract No. EP-S5-06-02 (RAC 2), Work Assignment No. 014-ANLA-5201. SulTRAC is a joint venture between Sullivan International Group, Inc., and Tetra Tech EM Inc. Under this work assignment, SulTRAC was asked to collect sediment samples from Duck and Otter Creeks in the Maumee River Area of Concern (MAOC) near Toledo, Ohio, analyze the samples for chemicals of concern, test the samples for toxicity, and report the findings of the investigation.

This report discusses the project background (Section 2.0), the field survey and sampling activities (Section 3.0), sediment sample results (Section 4.0), the quality control (QC) evaluation of data (Section 5.0), and conclusions and recommendations based on the sample data (Section 6.0). References used to prepare this report are listed after Section 6.0. Appendix A contains figures generated for the report. Appendix B contains data summary tables. Appendix C contains data validation reports. Appendix D presents sediment toxicity testing results. Appendix E contains a summary of sediment volume data.

2.0 PROJECT BACKGROUND

This section discusses the site location and description, results of previous investigations, and the sampling objectives.

2.1 SITE BACKGROUND AND SETTING

Duck and Otter Creeks are two small streams within the MAOC, and both are affected by point source and non-point source pollution. Otter Creek is 7 miles long, and Duck Creek is 4 miles long (Figure A-1). Otter Creek flows northeasterly through portions of Toledo and Oregon, Ohio, and then empties into south Maumee Bay. Duck Creek lies west of Otter Creek and enters the mouth of the Maumee River, which empties into Maumee Bay.

The MAOC is identified as the area extending from the Bowling Green water intake along the Maumee River at river mile 22.8 downstream to Maumee Bay, including the entire bay and nearshore waters from the Michigan state line to Crane Creek State Park in Ohio. This area includes Swan Creek, the Ottawa River (Ten Mile Creek), Duck Creek, Otter Creek, Cedar Creek, Grassy Creek, and Crane Creek. Duck and Otter Creeks are located within the Toledo metropolitan area.

The habitat and water quality of the MAOC have changed dramatically during the past century. The Maumee Bay watershed was once known as the Great Black Swamp, and the bay itself was considered the most prolific spawning ground in Lake Erie. Duck and Otter Creeks are comparatively small, but they have been the focus of attention for chemical contamination because their watersheds are dominated by urban and industrial development.

The Duck and Otter Creeks watershed within the MAOC has been an urban and industrial hub on Lake Erie for more than 100 years. As a result, the health of both creeks has been impaired over time. Historical impacts on the creeks have included major habitat modifications, such as rerouting and channeling the streams, and degradation of water and sediment quality. Despite significant improvements in the water quality of the creeks, contamination of sediment and surface water remains a concern.

Both creeks flow through heavily industrialized and commercial areas. In particular, the downstream-most mile of each creek passes through heavily industrialized and relatively isolated areas. Portions of Duck and Otter Creeks also flow through residential areas, and some yards open directly onto the creeks. The creeks also pass close to school yards, and Duck Creek flows through the Collins Golf Course. A

wooded area along Otter Creek near Starr Avenue is used as a paint ball field. In addition, signs of all-terrain vehicles have been observed near both creeks. All of these situations afford the opportunity for individuals to play, walk along, or wade in the creeks. Therefore, exposure to contaminated sediment is possible through several complete or potentially complete exposure pathways. The deepest areas of both creeks are the downstream portions (north ends), where security concerns have made access difficult (Tetra Tech 2005a).

2.2 SUMMARY OF PREVIOUS INVESTIGATIONS

Many previous investigations at Duck and Otter Creeks have been conducted by the Ohio Environmental Protection Agency (OEPA). The OEPA studies are typically part of an evaluation of the MAOC and include overall stream quality (OEPA 1994 and 1998, 1992 to 1998, and 1995; AS&I 1997) and stream quality in the vicinity of specific disposal or industrial operations along Duck and Otter Creeks (OEPA 1997a, 1997b, 1997c, and 1998). Secondary data are also available as a result of the following activities:

- Investigations of industrial operations along Duck and Otter Creeks (PTRL 1997a and 1997b; ENVIRON and Mannik and Smith 2003)
- Spill reports prepared by the City of Oregon (City of Oregon 2003, 2004a, 2004b, 2005a, 2005b, and 2005c)
- Investigation of a release from the City of Toledo wastewater treatment plant lime sludge ponds (City of Toledo 1988)
- Investigations of Hecklinger Pond (BEC 1998, 2003, and 2004; ETC 1989; OEPA 2003b; TTL 1988; City of Toledo 1989a, 1989b, and 1991; and WSU 1991)

Previous results for sediment are briefly described below.

Sediment in Duck and Otter Creeks has been sampled at a number of locations over the past 15 years. As noted above, much of the available data are from studies or sampling efforts conducted by OEPA as part of an evaluation of the MAOC. Additional analytical data have been generated through (1) investigations of industrial operations along Duck and Otter Creeks, (2) preparation of reports on spills and releases, and (3) investigations of potential polychlorinated biphenyl (PCB) contamination in fish in Hecklinger Pond (located at the head of Duck Creek). Analytes and sampling locations are highly variable, however. Portions of the watershed — especially the southern two-thirds of Otter Creek — have been sampled only a limited number of times and have not been sampled and analyzed at all since 1994, more than 10 years ago.

Another concern is associated with the data collected under the Phase III – 1997 OEPA sampling program in Otter Creek. Sediment samples were collected from the interface between surface water and sediment, the biologically active zone, and at depths of several feet below the surface water interface (OEPA 1992 to 1998). The data for these deeper samples are of limited value for assessing current risks, but would be helpful in assessing potential future exposure if sediment were to be removed as part of a rehabilitation or remediation program. Once the upper sediments are removed, deeper sediments would be exposed to receptor contact, and these risks would need to be evaluated.

The data collected in 2002 are likely the most accurate representation of sediment conditions; however, these data are from only a limited portion of Otter Creek. Thus, the sediment data available for Duck and Otter Creeks do not provide a complete understanding of current sediment conditions.

The results of past studies and investigations were briefly summarized in a data gap analysis technical memorandum (TM) prepared by Tetra Tech EM Inc. (Tetra Tech 2005b). The TM identified likely chemicals of potential concern (COPC) for sediment and data gaps that currently exist at the site. The data gaps identified include:

- The majority of data available for the site are more than 10 years old. These data are of limited value because of the length of time since some were collected. These data may provide an understanding of potential contamination in this area; however, conditions may have changed significantly since these sediment samples were collected.
- Most sediment samples were analyzed using routine analytical techniques; however, some samples were analyzed using screening analytical procedures, such as immunoassay tests. A sediment quality assessment notes a poor correlation between results from the immunoassay tests and the fixed laboratory (ChemRisk 1999). Although EPA encourages the use of field screening analytical techniques (EPA 2004), screening data must have a reasonable correlation to results from the fixed laboratory. Field screening data cannot be used for assessing potential risks because of the poor correlation.
- More current data are needed, especially in the southern portions of the watershed.
- Limited chemical data are available on the sediments that will help evaluate the bioavailability of metals and contamination by non-polar organic compounds. The collection of data for acid volatile sulfides and simultaneously extractable metals (AVS/SEM) will help evaluate whether metals are bound to sulfides and are therefore not bioavailable. In addition, collection of data on total organic carbon (TOC) will help evaluate the equilibrium relationship between non-polar organic compounds in solution and bound to the sediments and their subsequent bioavailability.

As a result of these data gaps, analysis of Duck and Otter Creek sediment samples for AVS/SEM and TOC was recommended, and both parameters were included in the current study. In addition, the current study included toxicity testing of several sediment samples using the midge species *Chironomus tentans*.

SulTRAC collected additional sediment samples at the site in April 2007 to address the data gaps identified above.

2.3 SAMPLING OBJECTIVES

The primary purpose of the sampling and analysis conducted by SulTRAC was to obtain data for sediment that can be used to complete up-to-date risk assessments for Duck and Otter Creeks. The data will be used by the Duck and Otter Creeks Partnership, Inc., which has planned a two-phase human health and ecological risk assessment study for Duck and Otter Creeks. The Partnership is a voluntary non-profit organization whose members include citizens, local businesses, industries, government agencies, institutions, and public organizations dedicated to promoting human and ecological health through education, protection, and restoration of these watersheds with diverse collaborative efforts dedicated to building community stewardship. The Partnership's goal for the risk assessment is "to determine whether sediment contaminants pose a significant risk to human health or the environment, and if so, to identify specific chemicals contributing to toxicity and define the spatial extent of risks [to human and ecological receptors]" (Partnership 2004).

In addition to the primary objective of providing data for risk assessments, data collected during this project may be used for several other purposes. These purposes may include (1) identifying areas in both creeks that may require remediation; (2) developing preliminary estimates of sediment removal volumes; (3) identifying areas that may be suitable for habitat restoration; (4) preparing the partnership to take steps toward delisting specific beneficial use impairments in the creeks; and (5) preparing the partnership for obtaining Great Lakes Legacy Act funding for any sediment remediation that may be required.

SulTRAC achieved these objectives by completing the activities summarized below:

- Collected sediment samples from 19 locations in Duck Creek and 27 locations in Otter Creek. All samples were analyzed for metals, polynuclear aromatic hydrocarbons (PAHs), PCBs, pesticides, TOC, oil and grease, and grain size. The analytical results were compared to reference limits where applicable and are included in Tables B-2 through B-5 and B-8 in Appendix B. Samples from 16 locations designated as "master" stations were also analyzed for AVS/SEM, full-scan PAHs, and toxicity testing. The additional master station analyses were performed to provide additional data required for future risk assessment activities. The AVS and full-scan

PAH analytical results are included in Tables B-6 and B-7 in Appendix B. The toxicity data is included in Appendix D.

- Measured the water depth and thickness of surface sediment at each sampling location. Additional depths and thicknesses were measured from five locations (OC-01A through OC-05A) between OC-01 and OC-06 in Otter Creek. A summary of the sediment thickness results is included in Appendix E.
- Arranged for analysis of samples by the EPA Region 5 Central Regional Laboratory (CRL), Severn Trent Laboratories, Inc. (STL), and American Aquatic Testing, Inc. (AAT).
- Validated analytical data generated by all laboratories that participated in the project and prepared summary data validation reports

In addition, sediment sample results will be integrated into an existing geographic information system (GIS) database that includes data collected during previous investigations of Duck and Otter Creeks.

3.0 FIELD SURVEY AND SAMPLING ACTIVITIES

This section discusses the water depth and sediment thickness survey, the sediment sampling locations and positioning, sediment sampling methods, and QC sampling conducted by SulTRAC. All field activities were conducted in accordance with the EPA-approved quality assurance project plan and field sampling plan (QAPP/FSP) prepared by SulTRAC (SulTRAC 2007).

3.1 WATER DEPTH AND SEDIMENT THICKNESS SURVEY

SulTRAC conducted a survey of water depth and sediment thickness to delineate the spatial extent of soft sediment deposits for sampling. Cross-channel water depth and sediment thickness surveys were conducted at each sampling location throughout the entire stretch of both Duck and Otter Creeks. Additionally, five locations between sampling locations OC-01 and OC-06 along Otter Creek were surveyed. At each location, depths and thicknesses at three positions perpendicular to stream flow were obtained (centerline and midway between the centerline from each bank). Water-level indicator paste was applied to a staff gauge or similar measurement device with 0.2-foot increments and carefully lowered into the water until met with slight resistance. This measurement was recorded and the paste was then re-applied. The device lowered into the water again until met with firm resistance and the measurement recorded. The difference of the two measurements yielded the surface sediment depth for that location.

The creek is divided into segments that correspond to various exposure areas. Therefore, each creek segment represents a unique exposure area and sediment volumes were calculated for each exposure area/creek segment. The sediment thickness and creek width measurements collected at various cross sections within in a particular creek segment were used for calculating the sediment volumes for the corresponding creek segment.

An estimated sediment thickness for each sample location was calculated using an average of every sediment thickness measurement at the sample cross section. For each creek segment, an average sediment thickness for the exposure area was calculated using the estimated sediment thickness at every sample location within an exposure area. Similarly, an average creek width for an exposure area was calculated using the width measured at every sample location within an exposure area. The length of each creek segment was calculated using X-Tools extension of Arc GIS 9.1.

The approximate sediment volume in each exposure area was calculated as the product of corresponding average sediment thickness, average creek width, and creek length. Hecklinger Pond was digitized and the pond area was obtained by X-Tools extension of Arc GIS 9.1. The appropriate sediment volume in Hecklinger Pond was calculated as the product of pond area and average sediment thickness of measurements in the pond. The approximate total sediment volume for each creek is equal to the summation of the sediment volume for every exposure area.

The results of the surveys indicate that approximately 812,700 cubic feet (30,100 cubic yards) of soft sediment deposits exist in Duck Creek (including Hecklinger Pond) and that approximately 2,017,200 cubic feet (74,700 cubic yards) exist in Otter Creek. Appendix E contains a summary of sediment depth data collected and estimated sediment volumes for each creek.

3.2 SEDIMENT SAMPLING LOCATIONS AND POSITIONING

EPA and SulTRAC selected sediment sampling locations for this study using professional judgment, with the primary objectives of addressing data gaps in previous sediment sampling investigations and providing coverage of the entire lengths of Duck and Otter Creeks. Exposure areas were defined in a previous screening-level risk assessment conducted for Duck and Otter Creeks and consider land use patterns around the creeks (Tetra Tech 2005c). The sampling design initially included 16 locations in Duck Creek and 26 locations in Otter Creek. Sampling locations DC-17, DC-18, and DC-19 in Duck Creek were added during preparation of the QAPP/FSP and OC-21a in Otter Creek was added based on observations in the field and discussions with EPA. Therefore, sediment samples were collected from 19 locations in Duck Creek and 27 locations in Otter Creek. The majority of sampling locations were spaced at intervals of approximately 0.25 mile and are shown on Figure A-1.

EPA and SulTRAC also considered surrounding land use in selecting sampling locations. Some samples were collected from stream segments adjacent to active and former industrial operations and waste disposal sites within each creek. Other locations were selected because they are adjacent to residential areas or potentially sensitive ecological habitats, such as wetlands.

3.3 SEDIMENT SAMPLING METHODS

Sediment samples were collected from the upper 6 to 12 inches of sediment from the base of Duck and Otter Creeks using a Ponar or stainless-steel shovels and hand trowels. SulTRAC began sampling each creek on each day at the location farthest downstream and approached each location from the downstream

side to avoid disturbing an area to be sampled. Sediment samples were collected from depositional environments (such as slow-moving pools) if present. SulTRAC collected multiple grab samples within an area approximately 5 feet in diameter. The multiple grab samples were placed into Ziploc bags, stainless steel bowls, or disposable containers. After any non-sediment material (such as rocks, twigs, or leaves) had been removed, SulTRAC homogenized the sediment in the Ziploc bag, stainless steel bowl, or disposable container and then transferred the sediment into sample containers. This method of sample collection was selected to provide a more representative estimate of contaminant concentrations in sediment at each location than would be obtained from a single grab sample. In addition, SulTRAC used the global positioning system (GPS) unit to record the precise location of each sediment sample collected. Sediment sample location coordinates recorded using GPS are included in Table B-1 in Appendix B.

3.4 QUALITY CONTROL SAMPLING

Equipment rinsate samples were collected to demonstrate whether decontamination procedures were effective in removing contaminants from the field sampling equipment. Equipment rinsate samples were collected during sediment sampling at a frequency of one sample for each type of sampling equipment used. Equipment rinsate samples were collected after a sampling device was subjected to standard decontamination procedures. Water was poured over or through the sampling equipment into a sample container and sent to the laboratory for analysis. Analytically certified, organic-free water was used for organic parameters; distilled water was used for inorganic parameters. Two equipment rinsate samples were collected for this sampling event.

Field sampling precision is evaluated by analyzing field duplicate samples. However, it is not practical to obtain true field duplicate samples because of the heterogeneous nature of sediments and the small amount of sediment that is analyzed. Field duplicate samples cannot be used directly to assess sampling precision because adjacent sediment samples incorporate some spatial variability. Furthermore, it is not practical to set QC limits for the relative percent difference (RPD) of field duplicate sediment samples, which precludes their use for QC. Therefore, in accordance with the approved QAPP, field duplicate samples were not collected.

Laboratory analytical precision was evaluated by analyzing laboratory duplicates or matrix spikes and matrix spike duplicates (MS/MSD). For this project, MS/MSD samples were generated at a frequency of 1 per 20 sediment samples for all chemical parameters. Samples DC-08, OC-11, and OC-26 were designated as MS/MSD samples. Additional sample volume was not required when an MS/MSD sample was collected.

4.0 SEDIMENT SAMPLE RESULTS

Pesticide, PCB, PAH, and metals results were compared with the Ecological Reference Limits (ERL) and Human Health Reference Limits (HHRL) established for this project and identified in the QAPP/FSP. The full-scan PAH analysis expands the normal PAH parameter list by including alkyl-substituted PAHs, which may be more toxic than the parent PAH compounds (SulTRAC 2007). Full-scan PAH data will be used in future risk assessment activities and are not discussed in this report. Reporting limits for some of the analytes were above the reference limits established and were identified in the EPA-approved QAPP. In addition, SulTRAC evaluated the relative concentrations by exposure area. Section 4.1 below discusses the analytical results for the sediment samples collected from Duck Creek. Section 4.2 discusses the analytical results for the sediment samples collected from Otter Creek. Section 4.3 presents a summary of the sample results. Figures A-2 and A-3 in Appendix A show total PAHs, total PCBs, arsenic, cadmium, and lead concentrations for each sampling location. These COPCs were the most prevalent throughout the site.

4.1 SAMPLE RESULTS FOR DUCK CREEK

This section discusses results for samples collected within Duck Creek, which was divided into Exposure Areas DC-A through E. Figures A-2 and A-3 in Appendix A and Tables B-2 through B-8 in Appendix B summarize sampling results for each sample location.

4.1.1 Pesticides

A total of 19 samples were collected from Duck Creek, and all contained two pesticide compounds (4,4'-dichlorodiphenyldichloroethane [4,4'-DDD] and 4,4'-dichlorodiphenyldichloroethene [4,4'-DDE]) at concentrations that exceeded the ERL. The concentrations of 4,4'-DDD ranged from 0.00764 to 0.388 milligrams per kilogram (mg/kg). These concentrations were above the ERL of 0.000509 mg/kg but below the HHRL of 2.4 mg/kg. The concentrations of 4,4'-DDE ranged from 0.0044 to 0.285 mg/kg. Again, these concentrations were above the ERL of 0.000261 mg/kg but below the HHRL of 1.7 mg/kg.

In addition, eight samples contained 4,4'-dichlorodiphenyltrichloroethene (4,4'-DDT) at concentrations that exceeded the ERL. These concentrations ranged from 0.00313 to 0.0502 mg/kg and were above the ERL of 0.000266 mg/kg but below the HHRL of 1.7 mg/kg. Four samples contained concentrations of heptachlor epoxide above the ERL, ranging from 0.00786 to 0.0147 mg/kg. These concentrations exceed the ERL of 0.000173 mg/kg but are below the HHRL of 0.053 mg/kg. One sample also contained a

concentration of heptachlor (0.00392 mg/kg) that exceeded the ERL of 0.000537 mg/kg but that was below the HHRL of 0.11 mg/kg.

The elevated levels of heptachlor and heptachlor epoxide were from samples collected within exposure area DC-A. The elevated levels of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were found in samples collected from within each exposure area.

4.1.2 PCBs

PCBs were detected in 10 of the 19 samples collected from Duck Creek. Four sediment samples contained PCBs (Aroclors 1254 and 1260) at concentrations that exceeded the HHRL of 0.220 mg/kg. No ERL was established for evaluation of PCBs. Three samples contained Aroclor 1254 at concentrations that exceeded the HHRL, ranging from 0.231 to 0.259 mg/kg. One sample contained an Aroclor 1260 at a concentration of 0.295 mg/kg. These samples were collected from exposure areas DC-A (DC-01) and DC-E (DC-16, DC-17, and DC-18).

4.1.3 PAHs

All 19 samples collected from Duck Creek contained two PAH compounds (fluoranthene and pyrene) at concentrations that exceeded the ERL. The concentrations of fluoranthene ranged from 0.182 to 190 mg/kg, above the ERL of 0.0505 mg/kg but below the HHRL of 2,300 mg/kg. The concentrations of pyrene ranged from 0.141 to 150 mg/kg, again above the ERL of 0.036 mg/kg but below the HHRL of 2,300 mg/kg.

Anthracene was detected in 10 of 19 sediment samples and all 10 sample concentrations exceeded the ERL of 0.0151 mg/kg. These concentrations ranged from 0.076 to 0.374 mg/kg and did not exceed the HHRL of 22,000 mg/kg.

Benzo(a)anthracene was detected in 18 of 19 sediment samples and all 18 sample concentrations exceeded the ERL of 0.0132 mg/kg. These concentrations ranged from 0.0712 to 87.2 mg/kg. In addition, 10 of the sediment samples contained concentrations that exceeded the HHRL of 0.620 mg/kg. Sample concentrations that exceeded the HHRL were from exposure areas DC-B (DC-06, DC-07, and DC-08), DC-C (DC-08, DC-09, and DC-10), DC-D (DC-10 and DC-13), and DC-E (DC-13, DC-14, DC-16, DC-17, and DC-18).

Benzo(a)pyrene was detected in 18 of 19 sediment samples and all 18 sample concentrations exceeded the ERL of 0.0205 mg/kg and the HHRL of 0.062 mg/kg. The concentrations ranged from 0.0712 to 82.5 mg/kg.

Benzo(b)fluoranthene was detected in 13 of 19 sediment samples and all 13 sample concentrations exceeded the ERL of 0.474 mg/kg. These concentrations ranged from 0.567 to 10.7 mg/kg. In addition, 12 of the sediment samples contained concentrations that exceeded the HHRL of 0.620 mg/kg. Sample concentrations that exceeded the HHRL were from exposure areas DC-A (DC-02), DC-B (DC-06, DC-07, and DC-08), DC-C (DC-08, DC-09, and DC-10), DC-D (DC-10, DC-11, and DC-13), and DC-E (DC-13, DC-14, DC-16, DC-17, and DC-18).

Benzo(k)fluoranthene was detected in 16 of 19 sediment samples and all 16 sample concentrations exceeded the ERL of 0.0139 mg/kg. These concentrations ranged from 0.0734 to 38.6 mg/kg. In addition, one sediment sample (DC-14) contained a concentration that exceeded the HHRL of 6.2 mg/kg. Sample location DC-14 is located in exposure area DC-E.

Chrysene was detected in 18 of 19 sediment samples and all 18 sample concentrations exceeded the ERL of 0.0195 mg/kg. These concentrations ranged from 0.0898 to 80.9 mg/kg. In addition, one sediment sample (DC-14) contained a concentration that exceeded the HHRL of 62 mg/kg. Sample location DC-14 is located in exposure area DC-E.

Dibenzo(a,h)anthracene was detected in 10 of 19 sediment samples and all 10 sample concentrations exceeded the ERL of 0.006 mg/kg and the HHRL of 0.062 mg/kg. The concentrations ranged from 0.0707 to 9.74 mg/kg. Sample concentrations that exceeded the HHRL were collected from exposure areas DC-A (DC-01, DC-02, and DC-03), DC-B (DC-06 and DC-07), DC-C (DC-09 and DC-10), DC-D (DC-10 and DC-13), and DC-E (DC-13, DC-14 and DC-16).

Fluorene was detected in 9 of 19 sediment samples and all 9 sample concentrations exceeded the ERL of 0.0084 mg/kg. These concentrations ranged from 0.0728 to 8.72 mg/kg and did not exceed the HHRL of 2,700 mg/kg.

Indeno(1,2,3-c,d)pyrene was detected in 16 of 19 sediment samples and all 16 sample concentrations exceeded the ERL of 0.0193 mg/kg. These concentrations ranged from 0.103 to 32.9 mg/kg. In addition, four sediment samples contained a concentration that exceeded the HHRL of 0.62 mg/kg. Sample

concentrations that exceeded the HHRL were from exposure areas DC-B (DC-07), DC-D (DC-13), and DC-E (DC-13, DC-14 and DC-16).

Naphthalene was detected in 9 of 19 sediment samples and all 9 sample concentrations exceeded the ERL of 0.0176 mg/kg. These concentrations ranged from 0.131 to 1.93 mg/kg and did not exceed the HHRL of 56 mg/kg.

Phenanthrene was detected in 18 of 19 sediment samples and all 18 sample concentrations exceeded the ERL of 0.0234 mg/kg. These concentrations ranged from 0.063 to 68.4 mg/kg and did not exceed the HHRL of 22,000 mg/kg.

4.1.4 Metals

All 19 samples collected from Duck Creek contained arsenic at concentrations that exceeded the ERL of 0.715 mg/kg and the HHRL of 0.39 mg/kg. The concentrations ranged from 5.48 to 140 mg/kg.

All 19 samples also contained cadmium and chromium concentrations that exceeded the ERL (0.0991 mg/kg cadmium and 2.02 mg/kg chromium) but not the HHRL (37 mg/kg cadmium and 100,000 mg/kg chromium). The cadmium concentrations ranged from 0.37 to 16.08 mg/kg. The chromium concentrations ranged from 15.9 to 190 mg/kg.

Lead was detected in all 19 samples at concentrations that exceeded the ERL of 3.53 mg/kg. Two samples (DC-04 and DC-12) also contained concentrations that exceeded the HHRL of 400 mg/kg (402 and 1,076 mg/kg, respectively). The lead concentrations ranged from 68.5 to 1,076 mg/kg.

Mercury was detected in 15 of 19 sediment samples at concentrations that exceeded the ERL of 0.0158 mg/kg. These concentrations ranged from 0.08 to 6.82 mg/kg and did not exceed the HHRL of 23 mg/kg.

Silver was detected in two sediment samples (DC-07 and DC-12) at concentrations that exceeded the ERL of 0.044 mg/kg. These concentrations were 10.8 and 44.7 mg/kg and did not exceed the HHRL of 390 mg/kg.

4.1.5 Toxicity

Seven sediment samples were collected from Duck Creek and were used in toxicity testing to evaluate whether sediment may represent a significant threat to potential receptor organisms in sediment. The toxicity tests were evaluated for percent survival and any that did not detect a difference in survival (compared to a control sample) were evaluated for effect on growth by measuring the dry weight of the surviving organisms. The results of the toxicity testing are provided in Appendix D and are summarized in Table D-1.

In exposure area DC-A of Duck Creek, survival rates for two samples (DC-01 and DC-05) were significantly lower than the controls; the survival rate did not differ from the controls for one sample (DC-03). The evaluation of potential impacts on growth for this sediment sample (DC-03) did not observe a significant difference from the controls. Survival rates for the samples from exposure area DC-B (DC-05 and DC-08) both were significantly lower than the controls. In exposure area DC-C, the survival rate for one sample (DC-08) was significantly lower than the controls, while it did not differ for one sample (DC-10). The evaluation of potential impacts on growth for sediment sample DC-010 did not observe a significant difference from the controls. Survival rates for the samples from exposure areas DC-D (DC-10 and DC-13) and DC-E (DC-13 and DC-14) were similar to the controls. These sediment samples (DC-010, DC-13, and DC-14) were also evaluated for their potential impacts on growth and no significant difference from the controls was observed.

TABLE 1
SUMMARY OF TOXICITY TESTING - DUCK CREEK

Exposure Area/ Sample Location	Mean Percent Survival	Mean Percent Survival Statistically Different from Controls	Mean Dry Weight (grams)	Mean Dry Weight Statistically Different from Controls
Control	91.7	NA	1.3304	NA
Duck Creek A				
DC-01	43.3	Yes	NA	NA
DC-03	85	No	1.509	No
DC-05	40	Yes	NA	NA
Duck Creek B				
DC-05	40	Yes	NA	NA
DC-08	45	Yes	NA	NA
Duck Creek C				
DC-08	45	Yes	NA	NA
DC-10	83	No	1.5511	No
Duck Creek D				
DC-10	83	No	1.5511	No
DC-13	90	No	1.336	No
Duck Creek E				
DC-13	90	No	1.336	No
DC-14	86.7	No	1.474	No

NA = not applicable

4.1.6 Miscellaneous Parameters

Select samples were tested for TOC, oil and grease, AVS, SEM, grain size, and percent solids to assist in understanding the potential fate and transport and bioavailability of the contaminants in the sediments. The TOC values (presented in Table B-5) range from 4.33 percent at location DC-19 to a high of 169 percent at location DC-12. Oil and grease values ranged from not detected to 12,600 mg/kg; no apparent pattern was observed in the distribution of this constituent.

The AVS and SEM results as reported by the laboratory showed that the ratio of SEM to AVS was less than 1 for all samples tested (see Appendix B, Table B-7). This ratio indicates a high probability that most of the metals in the sediments may be bound to sulfides and so are not bioavailable (DiToro and others 2005).

The grain size and percent dry weight analysis for Duck Creek sediments are presented in Table B-8 in Appendix B. The percent solids weight ranged from 15.8 percent to a high of 76.9. Most sediment with a higher percent solids contain a high relative percentage of material retained by the 16 to 50 mesh sieve indicative of coarser sediments.

4.2 SAMPLE RESULTS FOR OTTER CREEK

This section discusses results for samples collected within Otter Creek Exposure Areas OC-A through OC-E. Figures A-2 and A-3 in Appendix A and Tables B-2 through B-7 in Appendix B summarize sampling results for each sample location.

4.2.1 Pesticides

4,4'-DDD was detected in 22 of 27 sediment samples at concentrations that exceeded the ERL. These concentrations ranged from 0.00358 to 0.180 mg/kg. These concentrations were above the ERL of 0.000509 mg/kg but below the HHRL of 2.4 mg/kg.

4,4'-DDE was detected in 23 of 27 sediment samples at concentrations that exceeded the ERL. These concentrations ranged from 0.00237 to 0.0209 mg/kg. These concentrations were above the ERL of 0.000261 mg/kg but below the HHRL of 1.7 mg/kg.

4.2.2 PCBs

PCBs were detected in 25 of the 27 samples collected from Otter Creek. Eleven sediment samples collected from Otter Creek contained PCBs (Aroclor 1254) at concentrations that exceeded the HHRL of 0.220 mg/kg. No ERL has been established for PCBs. The concentrations of PCBs that exceeded the HHRL ranged from 0.242 to 11.3 mg/kg and the samples were collected from exposure areas OC-A (OC-02, OC-03, OC-04, OC-05, OC-06, and OC-07), OC-B (OC-7 and OC-11), OC-C (OC-11, OC-16, and OC-17), OC-D (OC-20), and OC-E (OC-23).

4.2.3 PAHs

All 27 samples collected from Otter Creek contained 11 PAH compounds — anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene — at concentrations that exceeded the ERL.

The concentrations of anthracene ranged from 0.109 to 4.84 mg/kg and were above the ERL of 0.0151 mg/kg but below the HHRL of 22,000 mg/kg.

The concentrations of benzo(a)anthracene ranged from 0.305 to 18.4 mg/kg and were above the ERL of 0.0132 mg/kg. In addition, 23 of the sediment samples contained concentrations that exceeded the HHRL of 0.620 mg/kg. Only samples from exposure areas OC-A (OC-06), OC-D (OC-21A), and OC-E (OC-23 and OC-24) did not contain concentrations that exceeded the HHRL.

The concentrations of benzo(a)pyrene ranged from 0.294 to 20 mg/kg and were above both the ERL of 0.0205 mg/kg and the HHRL of 0.062 mg/kg.

The concentrations of benzo(b)fluoranthene ranged from 0.427 to 24.7 mg/kg and 26 of the 27 sample concentrations were above the ERL of 0.474 mg/kg. In addition, 24 of the sediment samples contained concentrations that exceeded the HHRL of 0.620 mg/kg. Only samples from exposure areas OC-A (OC-06) and OC-E (OC-23 and OC-24) did not contain concentrations that exceeded the HHRL.

The concentrations of benzo(k)fluoranthene ranged from 0.142 to 7.88 mg/kg and were above the ERL of 0.0139 mg/kg. In addition, one sediment sample (OC-22) contained a concentration that exceeded the HHRL of 6.2 mg/kg. Sample location OC-22 is located in exposure areas OC-D and OC-E.

The concentrations of chrysene ranged from 0.478 to 22.9 mg/kg and were above the ERL of 0.0195 mg/kg but below the HHRL of 62 mg/kg.

The concentrations of fluoranthene ranged from 0.641 mg/kg to 51.8 mg/kg and were above the ERL of 0.0505 mg/kg but below the HHRL of 2,300 mg/kg.

The concentrations of indeno(1,2,3-c,d)pyrene ranged from 0.111 to 17.7 mg/kg. These concentrations were above the ERL of 0.0193 mg/kg. In addition, 14 of the sediment samples contained concentrations that exceeded the HHRL of 0.620 mg/kg. Samples with concentrations that exceeded the HHRL were collected from exposure areas OC-A (OC-05), OC-B (OC-09 and OC-11), OC-C (OC-11, OC-14, OC-15, OC-16, OC-17, and OC-18), OC-D (OC-19, OC-20, OC-21, and OC-22), and OC-E (OC-22, OC-25, and OC-26).

Concentrations of phenanthrene ranged from 0.501 to 26.3 mg/kg and were above the ERL of 0.0234 mg/kg but below the HHRL of 22,000 mg/kg.

Concentrations of pyrene ranged from 0.874 to 44.8 mg/kg and were above the ERL of 0.036 mg/kg but below the HHRL of 2,300 mg/kg.

Acenaphthene was detected in 15 sediment samples at concentrations that exceeded the ERL of 0.0098 mg/kg. These concentrations ranged from 0.121 to 1.63 mg/kg and did not exceed the HHRL of 3,700 mg/kg.

Acenaphthylene was detected in 11 sediment samples at concentrations that exceeded the ERL of 0.0078 mg/kg. These concentrations ranged from 0.11 to 0.785 mg/kg and did not exceed the HHRL of 3,700 mg/kg.

Fluorene was detected in 23 sediment samples at concentrations that exceeded the ERL of 0.0084 mg/kg. These concentrations ranged from 0.113 to 2.39 mg/kg and did not exceed the HHRL of 2,700 mg/kg.

Naphthalene was detected in 21 sediment samples at concentrations that exceeded the ERL of 0.0176 mg/kg. These concentrations ranged from 0.109 to 1.45 mg/kg and did not exceed the HHRL of 56 mg/kg.

4.2.4 Metals

All 27 samples collected from Otter Creek contained arsenic at concentrations that exceeded the ERL of 0.715 mg/kg and the HHRL of 0.39 mg/kg. The concentrations ranged from 6.67 to 83.5 mg/kg.

All 27 samples also contained cadmium, chromium, and lead at concentrations that exceeded the ERL (0.0991 mg/kg cadmium, 2.02 mg/kg chromium, and 3.53 mg/kg lead) but not the HHRL (37 mg/kg cadmium, 100,000 mg/kg chromium, and 400 mg/kg lead). The cadmium concentrations ranged from 0.51 to 2.67 mg/kg. The chromium concentrations ranged from 28.4 to 399 mg/kg. The lead concentrations ranged from 66.7 to 397 mg/kg.

Mercury was detected in 24 sediment samples at concentrations that exceeded the ERL of 0.0158 mg/kg. These concentrations ranged from 0.08 to 0.77 mg/kg and did not exceed the HHRL of 23 mg/kg.

4.2.5 Toxicity

Nine sediment samples were collected from Otter Creek and were used for toxicity testing to evaluate whether the sediment may represent a significant threat to potential receptor sediment organisms. The toxicity tests were evaluated for percent survival and any that did not detect a difference in survival (compared to a control sample) were evaluated for effect on growth. The results of the toxicity testing are provided in Appendix D and are summarized in Table 2.

In exposure area OC-A of Otter Creek, survival rates for three samples (OC-03, OC-05, and OC-07) were significantly lower than the controls, while survival for one sample (OC-01) did not differ. The evaluation of potential impacts on growth for this sediment sample (OC-01) did not observe a significant difference from the controls. Survival rates for the samples from exposure area OC-B (OC-07 and OC-11) both were significantly lower than the controls. In exposure area OC-C, survival rates for both samples (OC-11 and OC-14) were significantly lower than the controls. Survival rates for the samples from exposure area OC-D (OC-19 and OC-22) both were significantly lower than the controls, and survival rates in exposure area OC-E (OC-22 and OC-26) were significantly lower than the controls.

TABLE 2
SUMMARY OF TOXICITY TESTING -OTTER CREEK

Exposure Area/ Sample Location	Mean Percent Survival	Mean Percent Survival Statistically Different from Controls	Mean Dry Weight (grams)	Mean Dry Weight Statistically Different from Controls
Control	91.7	NA	1.3304	NA
Otter Creek A				
OC-01	60	No	2.3783	No
OC-03	48.3	Yes	NA	NA
OC-05	16.7	Yes	NA	NA
OC-07	16.7	Yes	NA	NA
Otter Creek B				
OC-07	16.7	Yes	NA	NA
OC-11	43.3	Yes	NA	NA
Otter Creek C				
OC-11	43.3	Yes	NA	NA
OC-14	51.7	Yes	NA	NA
Otter Creek D				
OC-19	53.3	Yes	NA	NA
OC-22	30	Yes	NA	NA
Otter Creek E				
OC-22	30	Yes	NA	NA
OC-26	35	Yes	NA	NA

NA = not applicable

4.2.6 Miscellaneous

Select samples were tested for TOC, oil and grease, AVS, SEM, grain size, and percent solids to assist in understanding the potential fate and transport and bioavailability of the contaminants in the sediments.

The sediment TOC values (presented in Table B-5) range from 1.79 percent at OC-19 to a high of 22.7 percent at OC-25. Oil and grease values ranged from not detected to 13,100 mg/kg. No apparent pattern was observed in the distribution of this constituent.

The AVS and SEM results as reported by the laboratory showed that the ratio of SEM to AVS in all samples tested was less than 1 (See Appendix B, Table B-7). This ratio indicates a high probability that most of the metals in the sediments may be bound to sulfides and so are not bioavailable (DiToro and other 2005).

The grain size and percent solids weight analysis for Otter Creek sediments are presented in Table B-8 in Appendix B. The percent solids weight ranged from 37.1 percent to a high of 77.5. Most sediment with a

higher percent solids contain a high relative percentage of material retained by the 16 to 50 mesh sieve indicative of coarser sediments.

4.3 SUMMARY OF SAMPLE RESULTS

A number of constituents detected in samples collected from both Duck and Otter Creek exceeded the ERLs. SulTRAC compiled total PAH and PCB concentrations for each sample location to gain a better understanding of where the relatively highest concentrations of PAHs and PCBs were located.

Compounds not detected were omitted from the total amount. The results of this compilation are shown in Figures A-2 and A-3 in Appendix A. A summary of contaminants detected in Duck and Otter Creeks is presented below.

Duck Creek

Total PAH concentrations detected at sample location DC-14 (801 mg/kg) were high compared with other total PAH concentrations in Duck Creek. This sample was collected in a sediment deposition area immediately adjacent to the manhole in Hecklinger Pond. The highest total PCB concentration was detected in sample DC-01 (0.488 mg/kg), located at the mouth of Duck Creek. Total PCB concentrations in samples collected from Hecklinger Pond (DC-14, DC-16, DC-17, and DC-18) were also relatively elevated. Lead concentrations from samples DC-04 and DC-12 exceeded the HHRL. DC-04 is located near the downstream refineries and railyards; DC-12 is located in the wetland area. Concentrations of arsenic, cadmium, chromium, and mercury from Duck Creek samples were fairly consistent throughout the creek.

There was no general trend of higher TOC values closer to the mouth of Duck Creek than farther upstream, as may be expected with sedimentation of finer particles nearer the mouth of the creek, where water velocity would be expected to be the slowest. It appears the TOC values may be influenced by a variety of factors.

Otter Creek

Total PAH concentrations detected at sample locations OC-09 (103 mg/kg), OC-17 (103 mg/kg), OC-20 (296 mg/kg), and OC-22 (257 mg/kg) were high compared with other total PAH concentrations in Otter Creek. Samples OC-20 and OC-22 were collected in the vicinity of the Sunoco Toledo Refinery. High total PCB concentrations were detected in samples OC-16 (11.3 mg/kg) and OC-23 (2.42 mg/kg). Total PCB concentrations in samples collected near the mouth of Otter Creek (OC-02, OC-03, OC-04, OC-05, and OC-06) were also elevated. Concentrations of arsenic, cadmium, chromium, lead, and mercury from Otter Creek samples were fairly consistent throughout the creek.

There was no general trend of higher TOC values closer to the mouth of Otter Creek than farther upstream, as may be expected with sedimentation of finer particles nearer the mouth of the creek where water velocity would be expected to be the slowest. It appears the TOC values may be influenced by a variety of factors.

5.0 QUALITY CONTROL EVALUATION OF DATA

All laboratory analytical results were validated as specified in the QAPP/FSP. The EPA Region 5 CRL analyzed all sediment samples for metals, pesticides, PCBs, PAHs, metals, TOC, oil and grease, and grain size. The EPA Region 5 CRL also analyzed two equipment rinsate blank samples for all of these parameters except grain size. STL analyzed a subset of 16 sediment samples for full-scan PAHs and AVS/SEM. Complete data validation results for both CRL and STL are presented in Appendix C.

No contaminants, other than trace amounts of TOC, were found in equipment rinsate blank samples. These results indicate that sediment sampling equipment was properly and effectively decontaminated between sampling locations and that cross-contamination between locations is unlikely.

No significant issues occurred with the analyses conducted by CRL and STL. The following observations were noted during data validation:

- Data validation identified a number of problems with CRL's results related to sample holding times; instrument calibration; surrogate, matrix spike, internal standard, and laboratory control sample recoveries; matrix spike duplicate and laboratory duplicate relative percent difference (RPD) results; and method blank contamination. In most cases, these problems affected a limited number of samples and analytes, and results were qualified as estimated, based on the specific problem. The one exception is the results for benzo(g,h,i)perylene. All results for this PAH were rejected because of widespread problems covering several of the QC checks listed above.
- Reporting limits for full-scan PAH results were higher than those listed in the QAPP/FSP because high concentrations of PAHs in some samples required dilution of these samples before analysis. In addition, the low solids content of some samples also contributed to elevated reporting limits.
- High relative percent differences (RPD) were noted for sample OC-26, which was selected for the matrix spike and matrix spike duplicate analysis. The high RPDs indicate significant heterogeneity in the distribution of the PAHs within this sample, and similar heterogeneities may exist in other samples.
- AVS percent recoveries for sample OC-26 were below laboratory control limits, suggesting matrix interference in this sample and that AVS results may be biased low. However, this observation does not affect conclusions regarding the SEM to AVS ratios. These ratios were all well below 1.0, indicating limited bioavailability of metals, and higher AVS concentrations would lower the ratios further.

Overall, most analytical results met the measurement quality objectives presented in the QAPP/FSP, the specific analytical methods used, and EPA data validation guidelines. The validated results are presented in Tables B-2 through B-8 and are acceptable for use as qualified.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the April 2007 sediment data, SulTRAC has drawn the conclusions summarized below.

- PAHs, PCBs, and metals concentrations detected in samples collected from Duck Creek exceeded ERLs and HHRLs at locations throughout the length of the creek.
- PAHs, PCBs, and metals concentrations detected in samples collected from Otter Creek exceeded ERLs and HHRLs at locations throughout the length of the creek.
- The highest total PCB concentrations detected in samples collected from Duck Creek are located in Hecklinger Pond sediment and locations closer to the mouth of the creek. Possible contaminant sources are nearby refineries and railyards, or an unknown source. If contamination is present in sediments present in Maumee Bay, there is a possibility that these sediments may be transported upstream by a seiche effect.
- The highest total PCB concentrations detected in samples collected from Otter Creek are located near the mouth of the creek (likely because of their proximity to nearby refineries and railyards and the potential for any contaminated sediment present at Maumee Bay to be carried upstream by seiche effect), near the refinery located upstream, and other scattered locations not associated with a potentially identifiable source.
- The highest total PAH concentrations detected in samples collected from Duck Creek were detected in the sediment sample collected from the east end of Hecklinger Pond (near the manhole).
- The highest total PAH concentrations detected in samples collected from Otter Creek were detected in samples collected near the upstream refinery and other scattered locations not associated with a potentially identifiable source.
- Toxicity greater than the controls was observed in most all samples from Otter Creek; only the sample at the mouth of the creek did not exhibit toxicity greater than the control. For Duck Creek, toxicity greater than the controls was observed in only three samples.
- The AVS/SEM data showed ratios less than one, indicating that sulfide concentrations in the sediment may be limiting the bioavailability of the metals in the sediments.
- There was no general trend of higher TOC or sediment percent solids values closer to the mouth of Otter Creek or Duck Creek than farther upstream, as may be expected with sedimentation of finer particles nearer the mouth of the creek where water velocity would be expected to be the slowest.

Based on these conclusions, SulTRAC offers the following recommendations:

- The ERA and HHRA should be conducted to help evaluate whether contaminated areas require sediment removal or other remedial actions. The risk assessments may also indicate whether additional areas should be sampled to further define any hot spots.
- To complete the HHRA, analytical results from sediment samples collected in Duck and Otter Creeks in 2007 may be used primarily to verify, and update if necessary, the COPCs selected for the HHRA and to calculate more robust and up-to-date exposure point concentrations (EPC) for each of the COPCs. More specifically, the 2007 data should be compared to historical data and,

based on factors discussed in EPA's "Guidance for Data Usability in Risk Assessment (Part A), Final" (EPA 1991), a decision can be made regarding the appropriate extent to which historical data may be combined with the 2007 sediment data for the purposes of conducting the HHRA. It is likely that the older available sediment analytical results (those for sediment samples collected before 2002) would not be retained for the purposes of selecting COPCs and calculating EPCs. Also, the overall conceptual site model (CSM) for the HHRA should remain largely unchanged since the previous risk assessment (Tetra Tech 2005c). Similarly, the significant majority of the exposure parameter assumptions (for example, exposure frequency, receptor ages and body weights, etc.) are also expected to remain unchanged. However, COPC-, location- (stream reach), exposure pathway-, and receptor-specific exposures, and associated risks and hazards should be revised to the extent that the COPCs and COPC-specific EPCs changed based on consideration of the 2007 sediment analytical data.

- Once the contaminants of potential ecological concern (COPEC) have been identified and concentrations identified this data may be used in several ways to assess the potential risks to ecological receptors. For the benthic organisms, the chemical concentration data should be evaluated with the toxicity data to determine if there is a specific constituent or chemical group that may be the cause of the toxicity. There are several approaches that may be used to conduct this evaluation. One would be to identify additional screening criteria and compare the EPCs to those criteria to identify those constituents that exceed the criteria as chemicals of concern (COC). The COCs for each sample would be compared to the toxicity results to identify any consistent COC or group of COCs that are associated with the sites with high toxicity. A regression analysis could be done between COC concentration and the toxicity results to statistically confirm if a relationship exists between a COC and observed toxicity. The grain size analysis data would also be further evaluated to determine if this could also be a contributing factor to the observed toxicity. Although the AVS/SEM data indicated limited bioavailability of the metals in the sediments, further evaluation that also takes into account the TOC should be performed to better understand the metals bioavailability. The TOC data should also be used to assess the bioavailability of the nonpolar organic constituents in the sediment, such as PAHs and some pesticides and potential impact on the observed toxicity. This data could be evaluated following the protocols outlined by Di Toro and others (2005), which factors AVS/SEM and TOC data to assess the potential for metals toxicity. The results of this analysis will help to understand the role metals may be playing in the observed toxicity. The TOC data and the organic contaminant results can be applied to the equilibrium partitioning model to assess their role in the observed toxicity DiToro (1991 and 2000a and b). The overall objective is to identify those chemicals that should be the focus of any future remedial actions.
- For other higher level organisms within the Duck and Otter Creek habitat, a food web model may be used to estimate the potential risks through direct contact and modeling the movement of the COPECs up the food chain and exposing these organisms to contaminants in the sediment and surface water. The protocols outlined in U.S. EPA's Ecological Risk Assessment for Superfund (ERAGS) (EPA 1997) and Ohio EPA's Guidance for Conducting Ecological Risk Assessment (OEPA 2003a).

REFERENCES

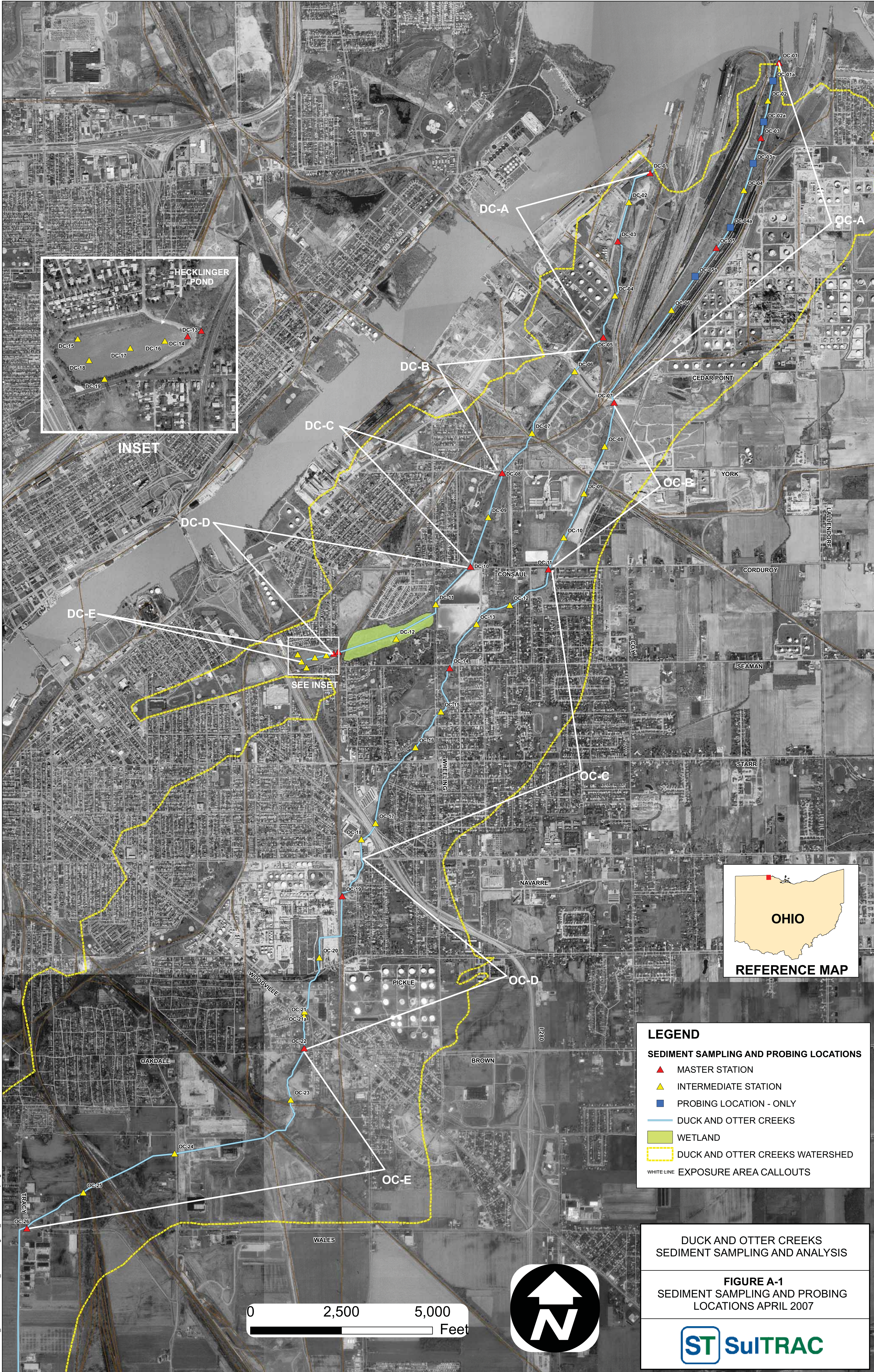
- ASCI Corporation (ASCI). 1997. Screening Analysis Sediment Quality Assessment Study of the Maumee River Area of Concern, Great Lakes National Program Office, 1995 & 1996, Lucas and Wood Counties, Ohio.
- BEC Laboratories, Inc. (BEC). 1998. Analytical Results for Fish Samples Collected from Hecklinger Pond on September 30, October 28, and October 29, 1998.
- BEC. 2003. Analytical Results for Surface Water Samples Collected from Duck Creek on October 15, 2003.
- BEC. 2004. Analytical Results for Surface Water Samples Collected from Duck Creek on May 12 and October 20, 2004.
- ChemRisk. 1999. "Sediment Quality Assessment for Duck and Otter Creeks, Toledo, Ohio." March 31.
- City of Oregon. 2003. "Illicit Discharge Detection and Elimination Incident Report" and Related Correspondence Regarding Leaking Underground Storage Tank at an Abandoned Greenhouse Property on Holms Street in Toledo, Ohio. March 5 through April 3.
- City of Oregon. 2004a. Analytical Results for Surface Water Samples Collected at Four Locations in Otter Creek in the Second through Fourth Quarters of 2004 as Part of the City's Storm Water Management Plan. May through November.
- City of Oregon. 2004b. "Illicit Discharge Detection and Elimination Incident Report" Regarding Leaking 12-Inch-Diameter Pipeline on Millard Avenue. August 25.
- City of Oregon. 2005a. "Illicit Discharge Detection and Elimination Incident Report" Regarding Diesel Spill from Truck (Reliance Propane) at 528 S. Wheeling. January 12.
- City of Oregon. 2005b. "Illicit Discharge Detection and Elimination Incident Report" Regarding Oil Sheen Observed in Marsh Area at Cedar Point and Otter Creek Roads. January 13.
- City of Oregon. 2005c. "Analytical Results for Surface Water Samples Collected at Four Locations in Otter Creek in the First Quarter of 2005" as Part of the City's Storm Water Management Plan. February.
- City of Toledo. 1988. Memorandum Regarding Analytical Results (Attached) for Duck Creek Sludge Samples. From T. Casey Stephens, Environmental Specialist, Environmental Services Division. To Richard Z. Uscilowski, Chief Chemist/Bacteriologist, and Lee Pfouts, Chief, Water Resources. June 2.
- City of Toledo. 1989a. Memorandum Regarding Environmental Testing and Certification Corporation Analytical Report No. 300364. From Greg Rucker, Chief, Division of Environmental and Consumer Health. Through Bill Scalzo, Director, Department of Natural Resources, and Richard L. Wenzel, M.D., Executive Director of Health. To Warner W. Plahs, Chief Landscape Architect. September 25.
- City of Toledo. 1989b. Memorandum Regarding Environmental Problems at Hecklinger Pond. From William C. Scalzo, Director, Department of Natural Resources. Through Philip A. Hawkey, City Manager. To Honorable Mayor and Members of City Council. November 3.

- City of Toledo. 1991. Memorandum Regarding Analyses of Fish Collected from the City of Toledo Low Service Pumping Station. From Donald M. Moline, P.E., Commissioner of Pollution Control, Department of Public Utilities. Through Michael J. White, Director, Department of Public Utilities. To Dura Task Force Members. October 10.
- DiToro, D.M., C.S. Zarba, D.J. Hansen, W. J. Berry, R.C. Swartz, C.E. Cowen, S.P. Pavlou, H.E. Allen, N.A. Thomas, and P. R. Paquin. 1991 "Technical basis for establishing sediment quality criteria for non-ionic Organic chemicals by using equilibrium partitioning. *Environ. Toxicol. Chem.* 10:1541-1583.
- DiToro, D.M, J.A. McGrath, and D.J. Hansen. 2000a. "Technical basis for narcotic chemicals and PAH criteria. I. Water and tissue." *Environ. Toxicol. Chem.* 19:1951-1970.
- DiToro, D.M, and J.A. McGrath. 2000b. Technical basis for narcotic chemicals and PAH criteria. II. Mixtures and sediments. *Environ. Toxicol. Chem.* 19:1971-1982
- DiToro, D.M., J. A. McGrath, D. J. Hansen, W. J. Berry, P. R. Paquin, R. Mathew, K. B. Wu, and R. C. Santore. 2005. *Predicting Sediment Metal Toxicity using a Sediment Biotic Ligand Model: Methodology and Initial Application*. Environmental Toxicology and Chemistry, Vol. 24, No. 10, pp. 2410-2427. October.
- Duck and Otter Creeks Partnership, Inc. (Partnership). 2004. Request for Proposals, Ecological and Human Health Risk Assessment for Duck and Otter Creeks. November.
- ENVIRON International Corporation (ENVIRON) and Mannik & Smith Group, Inc. (Mannik & Smith). 2003. Resource Conservation and Recovery Act Facility Investigation (RFI) Phase I Report and Phase II Work Plan, Envirosafe Services of Ohio, Inc., Otter Creek Road Facility, Oregon, Ohio. July.
- Environmental Testing and Certification Corporation (ETC). 1989. Analytical Report for One Fish Tissue Composite Sample Received from the City of Toledo. Analytical Report No. 300364. September 18.
- Ohio Environmental Protection Agency (OEPA). 1992 to 1998. Analytical Results for Phases I through III of Sediment and Surface Water Sampling in the Maumee River Area of Concern, Including Duck and Otter Creeks. Northwest District Office, Division of Surface Water.
- OEPA. 1994 and 1998. Results for Paired Toxicity Tests and Chemistry Analyses Conducted on Surface Sediment Samples Collected for Duck and Otter Creeks. Northwest District Office, Division of Surface Water.
- OEPA. 1995. A Report on the Whole Sediment Toxicity of 12 Sites in the Maumee River Area of Concern to *Hyaella azteca*. Bioassay Section, Division of Environmental Services. October.
- OEPA. 1997a. Maumee Remedial Action Plan Site Assessment Report for Phillips Petroleum (aka, Toledo Philiblack Plant, aka, River East Industrial Park), 275 Millard Avenue, Toledo, Ohio 43605. Lucas County. U.S. EPA ID No.: OHD 980 901 276. OEPA ID#: 348-0633. Northwest District Office, Division of Emergency and Remedial Response.
- OEPA. 1997b. Maumee Remedial Action Plan Site Assessment Report for Buckeye Pipe Line Company, 3321 York Street, Oregon, Ohio 43616. Lucas County. U.S. EPA ID No.: None. OEPA ID#: None. Northwest District Office, Division of Emergency and Remedial Response.

- OEPA. 1997c. Maumee Remedial Action Plan Site Assessment Report for Consaul Street Dump, 2510 Consaul Street, Toledo, Ohio 43605. Lucas County. U.S. EPA ID No.: OHD 980 826 119. OEPA ID#: 348-0200. Northwest District Office, Division of Emergency and Remedial Response.
- OEPA. 1998. Site Assessment Report for Westover Landfill, 820-920 Otter Creek Road, Oregon, Ohio 43616. Lucas County. U.S. EPA ID No.: OHD 000 606 368. OEPA ID#: 348-0901. Northwest District Office, Division of Emergency and Remedial Response.
- OEPA. 2003a. Guidance for Conducting Ecological Risk Assessment. Department of Emergency and Remedial Response. DERR-00-RR-031. February
- OEPA. 2003b. Analytical Results for Fish Samples Collected from Hecklinger Pond on October 20 and December 18, 2003. Division of Environmental Service.
- PTRL Environmental Services, Inc. (PTRL). 1997a. Wetlands Characterization Report, Chevron U.S.A. Toledo Refinery Site, Toledo, Ohio. March 12.
- PTRL. 1997b. Ecological Risk Assessment, Toledo Refinery Site, Toledo, Ohio. December 18.
- SulTRAC 2007. Quality Assurance Project Plan and Field Sampling Plan, Duck and Otter Creeks, Toledo and Oregon, Lucas County, Ohio. March 28.
- Tetra Tech EM Inc. (Tetra Tech). 2005a. Discussions Regarding Land Use in the Duck and Otter Creeks Watershed. Between Eric S. Morton, Senior Environmental Scientist, and Kristina Patterson, Watershed Coordinator, Partnership. February 2.
- Tetra Tech. 2005b. Data Gaps Analysis Ecological Risk Assessment Needs, Duck and Otter Creeks, Toledo and Oregon, Ohio, Technical Memorandum. October 19.
- Tetra Tech 2005c. Screening Human Health Risk Assessment, Duck and Otter Creeks, Toledo and Oregon Ohio. Prepared for Duck and Otter Creeks Partnership, Inc. October 28.
- Toledo Testing Laboratory, Inc. (TTL). 1988. Environmental Site Assessment of Hecklinger Pond and Its Adjacent Inlet, Seaman Road, Toledo, Ohio. December 29.
- U.S. Environmental Protection Agency (EPA). 1991. Guidance for Data Usability in Risk Assessment (Part A), Final. EPA/540/R-92/003. Office of Research and Development.
- EPA. 1997. Ecological Risk Assessment for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. EPA/540/R-97/006. Office of Solid Waste and Emergency Response.
- EPA. 2004. "Improving Sampling, Analysis, and Data Management for Site Investigation and Cleanup." OSWER. EPA-542-F-04-001a. April.
- Wright State University (WSU). 1991. Letter Regarding Analyses of Fish Samples Collected from Hecklinger Pond. From Thomas O. Tiernan, Ph.D., Professor of Chemistry, Director, Toxic Contaminant Research Programs. To Warner Plahs, Chief Park Planner, Department of Natural Resources, City of Toledo. August.

APPENDIX A
FIGURES

- A-1 SEDIMENT SAMPLING AND PROBING LOCATIONS APRIL 2007
- A-2 DOWNSTREAM SEDIMENT SAMPLE ANALYTICAL RESULTS APRIL 2007
- A-3 UPSTREAM SEDIMENT SAMPLE ANALYTICAL RESULTS APRIL 2007



G:\G9021\1Duck_Otter\DuckandOtter_GIS\MXD\Figure1_SedimentSampling.mxd aap CH-TTMM 08-23-07

SOURCE: AIRPHOTO USA 2000.

LEGEND

SEDIMENT SAMPLING AND PROBING LOCATIONS

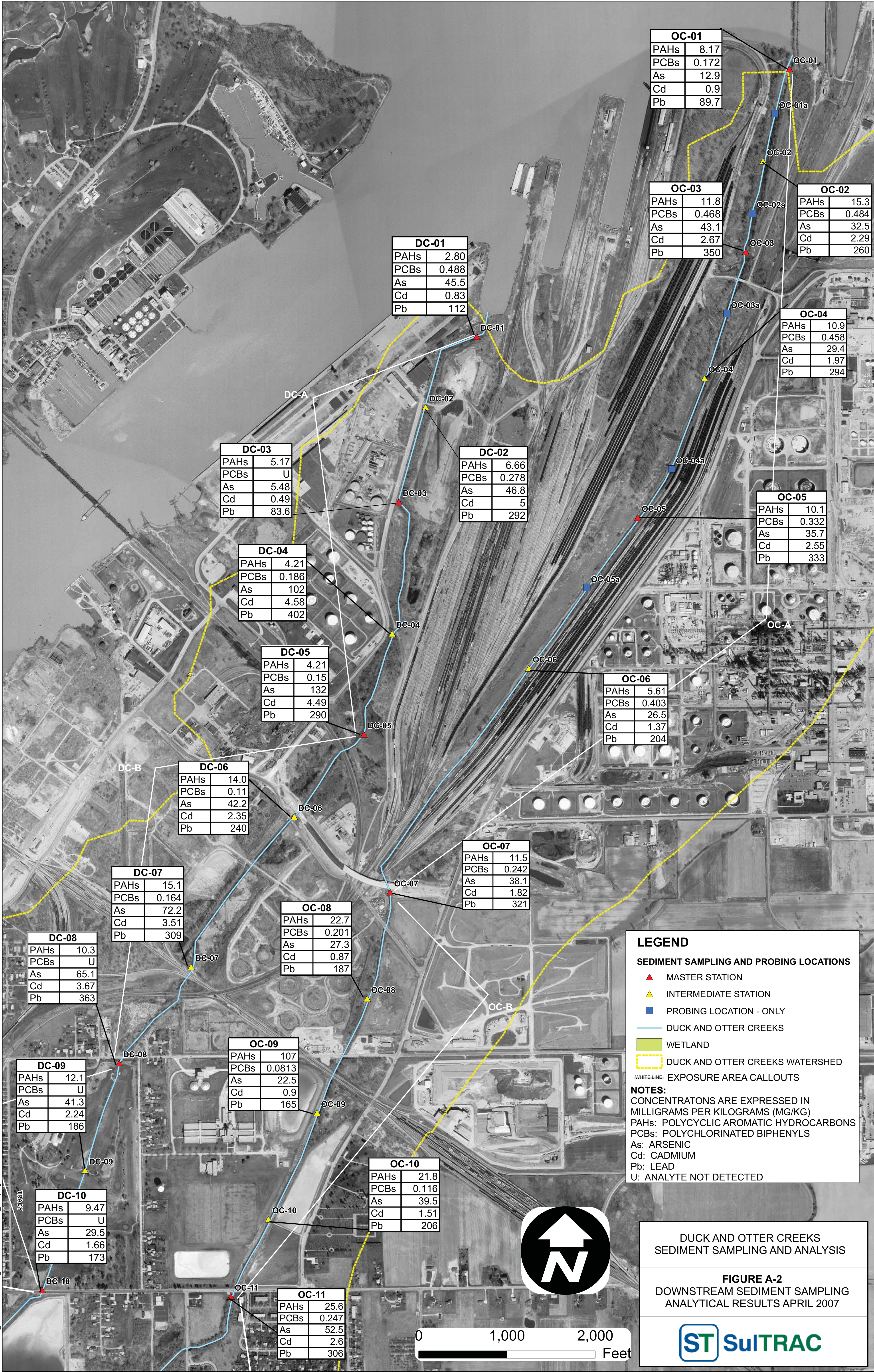
- ▲ MASTER STATION
- ▲ INTERMEDIATE STATION
- PROBING LOCATION - ONLY
- DUCK AND OTTER CREEKS
- WETLAND
- DUCK AND OTTER CREEKS WATERSHED
- WHITE LINE EXPOSURE AREA CALLOUTS

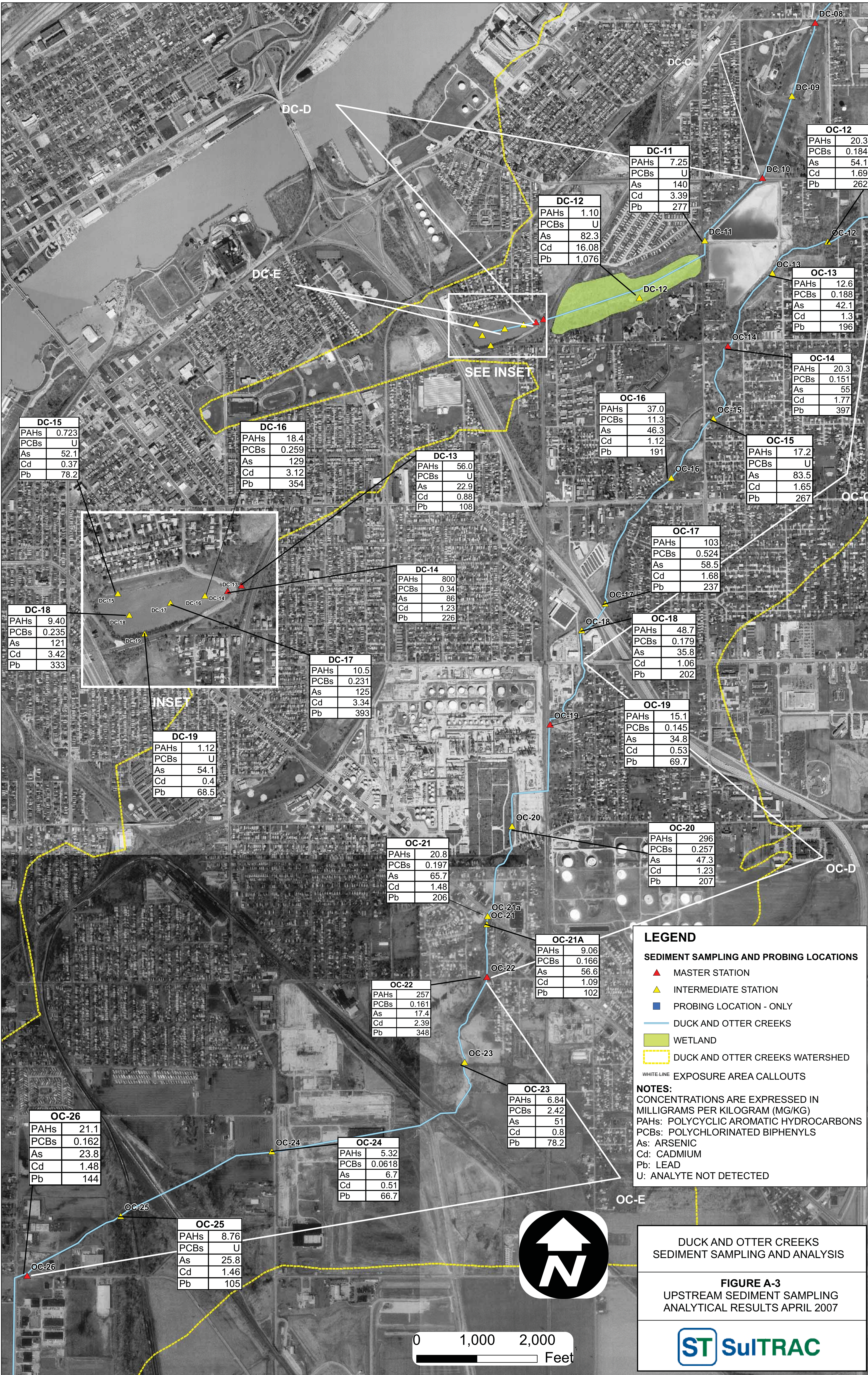
DUCK AND OTTER CREEKS
SEDIMENT SAMPLING AND ANALYSIS

FIGURE A-1
SEDIMENT SAMPLING AND PROBING
LOCATIONS APRIL 2007

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APPENDIX B

TABLES

B-1	SEDIMENT SAMPLE LOCATION COORDINATES
B-2	SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
B-3	SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
B-4	SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
B-5	SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL & GREASE
B-6	SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - FULL-SCAN PAHs
B-7	SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - AVS/SEM
B-8	SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS

TABLE B-1
SEDIMENT SAMPLING LOCATION COORDINATES
DUCK AND OTTER CREEKS,
TOLEDO AND OREGON, OHIO

Sample ID	Easting* (X)	Northing* (Y)	Longitude	Latitude
DC-01	1704636.144	738068.6415	-83.46605595	41.68845816
DC-02	1704057.046	737268.499	-83.46814345	41.68624485
DC-03	1703753.912	736194.2966	-83.46920945	41.68328786
DC-04	1703676.644	734701.3597	-83.46943155	41.67918868
DC-05	1703357.26	733559.9514	-83.47055412	41.67604676
DC-06	1702569.212	732626.117	-83.47340038	41.67346008
DC-07	1701399.582	730926.119	-83.47761153	41.66875915
DC-08	1700584.989	729833.6422	-83.48054781	41.66573614
DC-09	1700199.373	728619.8967	-83.481909	41.66239354
DC-10	1699711.065	727264.5836	-83.48363999	41.65865926
DC-11	1698759.246	726229.9713	-83.48708005	41.65579062
DC-12	1697676.731	725281.6392	-83.49100159	41.65315456
DC-13	1696087.292	724928.7954	-83.49680244	41.65213659
DC-14	1695962.434	724879.4219	-83.49725721	41.65199719
DC-15	1694972.637	724857.7715	-83.5008778	41.65190666
DC-16	1695757.664	724837.3469	-83.49800467	41.6518753
DC-17	1695445.607	724773.2731	-83.49914374	41.65168967
DC-18	1695074.753	724663.0053	-83.500496	41.65137541
DC-19	1695213.512	724495.8142	-83.4999813	41.65092098
OC-01	1708179.194	741098.8669	-83.45320646	41.69688046
OC-01a	1708015.396	740594.4283	-83.45378598	41.69549131
OC-02	1707878.575	740054.3199	-83.45426529	41.69400507
OC-02a	1707760.409	739465.3858	-83.45467432	41.69238541
OC-03	1707684.147	739028.0324	-83.45493599	41.69118297
OC-03a	1707469.941	738329.0131	-83.45569216	41.68925833
OC-04	1707217.99	737596.8509	-83.45658514	41.6872416
OC-04a	1706844.417	736567.3872	-83.45791133	41.68440537
OC-05	1706458.335	736016.4866	-83.45930247	41.68288198
OC-05a	1705883.546	735224.206	-83.46137456	41.68069048
OC-06	1705224.362	734309.6174	-83.46375047	41.67816076
OC-07	1703654.168	731771.6351	-83.46939462	41.67114843
OC-08	1703394.292	730565.5688	-83.47029663	41.66783088
OC-09	1702828.28	729271.6384	-83.47231529	41.66426284
OC-10	1702275.389	728066.0593	-83.47428933	41.66093762
OC-11	1701851.211	727191.1276	-83.47580572	41.65852366
OC-12	1700792.427	726209.4252	-83.47963968	41.65579714
OC-13	1699877.244	725689.9419	-83.48296696	41.65434334
OC-14	1699141.189	724482.9904	-83.48561026	41.65100848
OC-15	1698900.132	723283.0943	-83.48644257	41.6477083
OC-16	1698201.582	722303.9498	-83.48895767	41.64499966
OC-17	1697109.064	720222.671	-83.4928679	41.63925423
OC-18	1696720.153	719781.5401	-83.49427219	41.63803153
OC-19	1696196.886	718222.3806	-83.49612118	41.63373655
OC-20	1695567.053	716537.1888	-83.49835443	41.62909233
OC-21	1695150.083	714917.4445	-83.4998116	41.62463436
OC-21a	1695165.178	715050.2524	-83.49976196	41.62499929
OC-22	1695151.782	714045.5656	-83.49976883	41.62224183
OC-23	1694783.517	712633.1483	-83.50105635	41.6183543
OC-24	1691594.055	711156.6436	-83.51265735	41.61420146
OC-25	1689090.481	710087.8695	-83.52176641	41.61118841
OC-26	1687541.178	709102.107	-83.52738903	41.60843335

Note:

* = The coordinate system used is NAD83 Ohio State Plane Feet North

TABLE B-2
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S01-DC-01 4/02/07	S02-DC-02 4/02/07	S03-DC-03 4/02/07	S04-DC-04 4/02/07	S05-DC-05 4/03/07	S06-DC-06 4/03/07		
Aldrin	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	0.029	0.0005
Alpha-BHC	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	0.09	0.0006
Beta-BHC	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	0.32	0.0005
Gamma-BHC	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	0.44	0.233
Delta-BHC	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	0.09	7.15
Alpha-Chlordane	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	1.6	NA
Gamma-Chlordane	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	1.6	NA
4,4'-DDD	<i>0.089</i>	<i>0.0721</i>	<i>0.0218</i>	<i>0.0912</i>	<i>0.136</i>	<i>0.161</i>	2.4	0.000509
4,4'-DDE	<i>0.0473</i>	<i>0.0367</i>	<i>0.0107</i>	<i>0.0417</i>	<i>0.0622</i>	<i>0.0566</i>	1.7	0.000261
4,4'-DDT	0.00483 U	0.0102 U	<i>0.0191</i>	0.0106 U	0.0104 U	0.00888 U	1.7	0.000266
Dieldrin	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	0.03	0.000493
Endosulfan I	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	370	0.000297
Endosulfan II	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	370	0.000943
Endosulfan Sulfate	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	370	NA
Endrin	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	18	0.00046
Endrin Aldehyde	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	18	0.048
Endrin Ketone	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	18	NA
Heptachlor	0.00483 U	0.0102 U	<i>0.00392 J</i>	0.0106 U	0.0104 U	0.00888 U	0.11	0.000537
Heptachlor Epoxide	<i>0.0109</i>	<i>0.00786</i>	0.00521 U	<i>0.00907 J</i>	<i>0.0147</i>	0.00888 U	0.053	0.000173
Methoxychlor	0.00483 U	0.0102 U	0.00521 U	0.0106 U	0.0104 U	0.00888 U	310	0.00141

TABLE B-2
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S07-DC-07 4/02/07	S08-DC-08 4/02/07	S09-DC-09 4/02/07	S10-DC-10 4/03/07	S11-DC-11 4/03/07	S12-DC-12 4/03/07		
Aldrin	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	0.029	0.0005
Alpha-BHC	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	0.09	0.0006
Beta-BHC	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	0.32	0.0005
Gamma-BHC	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	0.44	0.233
Delta-BHC	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	0.09	7.15
Alpha-Chlordane	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	1.6	NA
Gamma-Chlordane	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	1.6	NA
4,4'-DDD	0.222	0.14	0.176	0.0783	0.388 H	0.277	2.4	0.000509
4,4'-DDE	0.0752	0.136	0.0727	0.061	0.201 H	0.285	1.7	0.000261
4,4'-DDT	0.0121 U	0.0372	0.0167	0.017	0.0502 H	0.0248	1.7	0.000266
Dieldrin	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	0.03	0.000493
Endosulfan I	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	370	0.000297
Endosulfan II	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	370	0.000943
Endosulfan Sulfate	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	370	NA
Endrin	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	18	0.00046
Endrin Aldehyde	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	18	0.048
Endrin Ketone	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	18	NA
Heptachlor	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	0.11	0.000537
Heptachlor Epoxide	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	0.053	0.000173
Methoxychlor	0.0121 U	0.0159 U	0.01 U	0.00801 U	0.0121 U, H	0.0224 U	310	0.00141

TABLE B-2
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S13-DC-13 4/04/07	S14-DC-14 4/04/07	S15-DC-15 4/04/07	S16-DC-16 4/02/07	S17-DC-17 4/02/07	S18-DC-18 4/02/07		
Aldrin	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	0.029	0.0005
Alpha-BHC	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	0.09	0.0006
Beta-BHC	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	0.32	0.0005
Gamma-BHC	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	0.44	0.233
Delta-BHC	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	0.09	7.15
Alpha-Chlordane	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	1.6	NA
Gamma-Chlordane	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	1.6	NA
4,4'-DDD	<i>0.136</i>	<i>0.0707</i>	<i>0.00787</i>	<i>0.0179</i>	<i>0.0198</i>	<i>0.0174</i>	2.4	0.000509
4,4'-DDE	<i>0.0727</i>	<i>0.0175</i>	<i>0.00723</i>	<i>0.0194</i>	<i>0.0199</i>	<i>0.019</i>	1.7	0.000261
4,4'-DDT	<i>0.0349</i>	0.00954 U	<i>0.00313 J</i>	0.0112 U	0.0109 U	0.0104 U	1.7	0.000266
Dieldrin	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	0.03	0.000493
Endosulfan I	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	370	0.000297
Endosulfan II	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	370	0.000943
Endosulfan Sulfate	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	370	NA
Endrin	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	18	0.00046
Endrin Aldehyde	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	18	0.048
Endrin Ketone	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	18	NA
Heptachlor	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	0.11	0.000537
Heptachlor Epoxide	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	0.053	0.000173
Methoxychlor	0.00616 U	0.00954 U	0.00609 U	0.0112 U	0.0109 U	0.0104 U	310	0.00141

TABLE B-2
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S19-DC-19 4/04/07	S20-OC-01 4/02/07	S21-OC-02 4/02/07	S22-OC-03 4/02/07	S23-OC-04 4/02/07	S24-OC-05 4/02/07		
Aldrin	0.00539 U	0.0541 U, MS, LS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	0.029	0.0005
Alpha-BHC	0.00539 U	0.0541 U, MS, LS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	0.09	0.0006
Beta-BHC	0.00539 U	0.0541 U, MS, LS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	0.32	0.0005
Gamma-BHC	0.00539 U	0.0541 U, MS, LS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	0.44	0.233
Delta-BHC	0.00539 U	0.0541 U, MS, LS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	0.09	7.15
Alpha-Chlordane	0.00539 U	0.0541 U, MS, LS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	1.6	NA
Gamma-Chlordane	0.00539 U	0.0541 U, MS, LS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	1.6	NA
4,4'-DDD	0.00764	0.0116 M, MS, LC	0.0252 LS, LC	0.0274 LS, LC	0.0152 LS, LC	0.0233 LS, LC	2.4	0.000509
4,4'-DDE	0.0044 J	0.00938 M, MS, LC	0.0178 LS, LC	0.0174 LS, LC	0.0138 LS, LC	0.0163 LS, LC	1.7	0.000261
4,4'-DDT	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	1.7	0.000266
Dieldrin	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	0.03	0.000493
Endosulfan I	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	370	0.000297
Endosulfan II	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	370	0.000943
Endosulfan Sulfate	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	370	NA
Endrin	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	18	0.00046
Endrin Aldehyde	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	18	0.048
Endrin Ketone	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	18	NA
Heptachlor	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	0.11	0.000537
Heptachlor Epoxide	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	0.053	0.000173
Methoxychlor	0.00539 U	0.0541 U, M, MS, LC	0.00743 U, LS, LC	0.00958 U, LS, LC	0.00798 U, LS, LC	0.00848 U, LS, LC	310	0.00141

TABLE B-2
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S25-OC-06 4/02/07	S26-OC-07 4/03/07	S27-OC-08 4/03/07	S28-OC-09 4/04/07	S29-OC-10 4/04/07	S30-OC-11 4/03/07		
Aldrin	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	0.029	0.0005
Alpha-BHC	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	0.09	0.0006
Beta-BHC	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	0.32	0.0005
Gamma-BHC	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	0.44	0.233
Delta-BHC	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	0.09	7.15
Alpha-Chlordane	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	1.6	NA
Gamma-Chlordane	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	1.6	NA
4,4'-DDD	0.0109 LS, LC	0.18 LS, LC	0.0157 LS, LC	0.0132 LS, LC	0.0153 LS, LC	0.0158 LS, LC	2.4	0.000509
4,4'-DDE	0.00972 LS, LC	0.00992 LS, LC	0.00843 LS, LC	0.00473 LS, LC	0.0102 LS, LC	0.00971 LS, LC	1.7	0.000261
4,4'-DDT	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	1.7	0.000266
Dieldrin	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	0.03	0.000493
Endosulfan I	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	370	0.000297
Endosulfan II	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	370	0.000943
Endosulfan Sulfate	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	370	NA
Endrin	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	18	0.00046
Endrin Aldehyde	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	18	0.048
Endrin Ketone	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	18	NA
Heptachlor	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	0.11	0.000537
Heptachlor Epoxide	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	0.053	0.000173
Methoxychlor	0.0071 U, LS, LC	0.00695 U, LS, LC	0.006 U, LS, LC	0.00521 U, LS, LC	0.00576 U, LC	0.00766 U, LC	310	0.00141

TABLE B-2
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S31-OC-12 4/03/07	S32-OC-13 4/03/07	S33-OC-14 4/03/07	S34-OC-15 4/03/07	S35-OC-16 4/03/07	S36-OC-17 4/03/07		
Aldrin	0.006 U, LC	0.00487 U, LS, LC	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	0.029	0.0005
Alpha-BHC	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	0.09	0.0006
Beta-BHC	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	0.32	0.0005
Gamma-BHC	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	0.44	0.233
Delta-BHC	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	0.09	7.15
Alpha-Chlordane	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	1.6	NA
Gamma-Chlordane	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	1.6	NA
4,4'-DDD	<i>0.0133 LS, LC</i>	<i>0.0141 LS</i>	<i>0.0125 LS</i>	<i>0.011</i>	0.00538 U	<i>0.0279</i>	2.4	0.000509
4,4'-DDE	<i>0.00608 LS, LC</i>	<i>0.00615 LS</i>	<i>0.00573 LS</i>	<i>0.00439 J</i>	0.00538 U	<i>0.0155</i>	1.7	0.000261
4,4'-DDT	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	1.7	0.000266
Dieldrin	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	0.03	0.000493
Endosulfan I	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	370	0.000297
Endosulfan II	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	370	0.000943
Endosulfan Sulfate	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	370	NA
Endrin	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	18	0.00046
Endrin Aldehyde	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	18	0.048
Endrin Ketone	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	18	NA
Heptachlor	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	0.11	0.000537
Heptachlor Epoxide	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	0.053	0.000173
Methoxychlor	0.006 U, LC	0.00487 U, LS	0.00537 U, LS	0.00617 U	0.00538 U	0.00502 U	310	0.00141

TABLE B-2
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S37-OC-18 4/03/07	S38-OC-19 4/03/07	S39-OC-20 4/03/07	S40-OC-21 4/03/07	S41-OC-21A 4/04/07	S42-OC-22 4/03/07		
Aldrin	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	0.029	0.0005
Alpha-BHC	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	0.09	0.0006
Beta-BHC	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	0.32	0.0005
Gamma-BHC	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	0.44	0.233
Delta-BHC	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	0.09	7.15
Alpha-Chlordane	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	1.6	NA
Gamma-Chlordane	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	1.6	NA
4,4'-DDD	0.0146	0.0101	0.0233	0.00708 J	0.00547	0.00358	2.4	0.000509
4,4'-DDE	0.00765	0.00666	0.0139	0.0066 J	0.00519 J	0.0209	1.7	0.000261
4,4'-DDT	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	1.7	0.000266
Dieldrin	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	0.03	0.000493
Endosulfan I	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	370	0.000297
Endosulfan II	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	370	0.000943
Endosulfan Sulfate	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	370	NA
Endrin	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	18	0.00046
Endrin Aldehyde	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	18	0.048
Endrin Ketone	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	18	NA
Heptachlor	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	0.11	0.000537
Heptachlor Epoxide	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	0.053	0.000173
Methoxychlor	0.00529 U	0.00427 U	0.00447 U, LS	0.00718 U	0.00539 U	0.00485 U	310	0.00141

TABLE B-2
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S43-OC-23 4/03/07	S44-OC-24 4/03/07	S45-OC-25 4/03/07	S46-OC-26 4/03/07	S47-ER-EK-01 4/04/07 (milligrams per liter)	S48-ER-SH-02 4/04/07 (milligrams per liter)		
Aldrin	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0366 U	0.0337 U	0.029	0.0005
Alpha-BHC	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0366 U	0.0337 U	0.09	0.0006
Beta-BHC	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0366 U	0.0337 U	0.32	0.0005
Gamma-BHC	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0336 U	0.0337 U	0.44	0.233
Delta-BHC	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0336 U	0.0337 U	0.09	7.15
Alpha-Chlordane	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0732 U	0.0674 U	1.6	NA
Gamma-Chlordane	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0732 U	0.0674 U	1.6	NA
4,4'-DDD	0.00485 U	0.00363 J	0.00586 U	0.00529 U	0.0732 U	0.0674 U	2.4	0.000509
4,4'-DDE	0.00485 U	0.00247 J	0.00586 U	0.00237 J	0.0366 U	0.0337 U	1.7	0.000261
4,4'-DDT	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.11 U	0.101 U	1.7	0.000266
Dieldrin	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0366 U	0.0337 U	0.03	0.000493
Endosulfan I	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.07332 U	0.0674 U	370	0.000297
Endosulfan II	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0366 U	0.0337 U	370	0.000943
Endosulfan Sulfate	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0732 U	0.0674 U	370	NA
Endrin	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0366 U	0.0337 U	18	0.00046
Endrin Aldehyde	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0366 U	0.0337 U	18	0.048
Endrin Ketone	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0732 U	0.0674 U	18	NA
Heptachlor	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0336 U	0.0337 U	0.11	0.000537
Heptachlor Epoxide	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.0366 U	0.0337 U	0.053	0.000173
Methoxychlor	0.00485 U	0.00462 U	0.00586 U	0.00529 U	0.146 U	0.0135 U	310	0.00141

Notes:

^a Human health reference limits taken from EPA Region 9 preliminary remediation goals (PRG) for residential soil exposure

^b Ecological reference limits were provided by EPA GLNPO

H = Estimated value. Holding time exceeded.

J = Estimated value. Greater than detection limit, but less than reporting limit.

LC = Estimated value. Lab control recoveries exceed upper or lower control limits.

LS = Estimated value. Batch quality control for laboratory surrogate exceeds upper or lower control limits.

M = Estimated value. Associated matrix spike/matrix spike duplicate recoveries exceed the upper or lower control limits.

MS = Estimated value. Relative percent difference between matrix spike/matrix spike duplicate exceeded specified criteria.

NA = Not available

U = Analyte not detected at or above reporting limit

Bold values exceed human health reference limits

Italicized values exceed ecological reference limits

All values are expressed in milligrams per kilogram unless otherwise noted

TABLE B-3
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S01-DC-01 4/02/07	S02-DC-02 4/02/07	S03-DC-03 4/02/07	S04-DC-04 4/02/07	S05-DC-05 4/03/07	S06-DC-06 4/03/07		
Aroclor 1016	0.145 U	0.306 U	0.156 U	0.317 U	0.312 U	0.266 U	3.90	NE
Aroclor 1221	0.0966 U	0.204 U	0.104 U	0.211 U	0.208 U	0.178 U	3.90	NE
Aroclor 1232	0.0966 U	0.204 U	0.104 U	0.211 U	0.208 U	0.178 U	3.90	NE
Aroclor 1242	0.0966 U	0.204 U	0.104 U	0.211 U	0.208 U	0.178 U	0.22	NE
Aroclor 1248	0.0966 U	0.204 U	0.104 U	0.211 U	0.208 U	0.178 U	0.22	NE
Aroclor 1254	0.193	0.141 J	0.104 U	0.186 J	0.15 J	0.11 J	0.22	NE
Aroclor 1260	0.295	0.137 J	0.125 U	0.253 U	0.25 U	0.213 U	0.22	NE

TABLE B-3
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S07-DC-07 4/02/07	S08-DC-08 4/02/07	S09-DC-09 4/02/07	S10-DC-10 4/03/07	S11-DC-11 4/03/07	S12-DC-12 4/03/07		
Aroclor 1016	0.362 U	0.476 U	0.3 U	0.24 U	0.363 U, H	0.673 U	3.90	NE
Aroclor 1221	0.242 U	0.317 U	0.2 U	0.16 U	0.242 U, H	0.449 U	3.90	NE
Aroclor 1232	0.242 U	0.317 U	0.2 U	0.16 U	0.242 U, H	0.449 U	3.90	NE
Aroclor 1242	0.242 U	0.317 U	0.2 U	0.16 U	0.242 U, H	0.449 U	0.22	NE
Aroclor 1248	0.242 U	0.317 U	0.2 U	0.16 U	0.242 U, H	0.449 U	0.22	NE
Aroclor 1254	0.164 J	0.317 U	0.2 U	0.16 U	0.242 U, H	0.449 U	0.22	NE
Aroclor 1260	0.29 U	0.381 U	0.24 U	0.192 U	0.291 U, H	0.538 U	0.22	NE

TABLE B-3
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S13-DC-13 4/04/07	S14-DC-14 4/04/07	S15-DC-15 4/04/07	S16-DC-16 4/02/07	S17-DC-17 4/02/07	S18-DC-18 4/02/07		
Aroclor 1016	0.185 U	0.286 U	0.183 U	0.335 U	0.327 U	0.312 U	3.90	NE
Aroclor 1221	0.123 U	0.191 U	0.122 U	0.223 U	0.218 U	0.208 U	3.90	NE
Aroclor 1232	0.123 U	0.191 U	0.122 U	0.223 U	0.218 U	0.208 U	3.90	NE
Aroclor 1242	0.123 U	0.191 U	0.122 U	0.223 U	0.218 U	0.208 U	0.22	NE
Aroclor 1248	0.123 U	0.191 U	0.122 U	0.223 U	0.218 U	0.208 U	0.22	NE
Aroclor 1254	0.123 U	0.195	0.122 U	0.259	0.231	0.235	0.22	NE
Aroclor 1260	0.148 U	0.145 J	0.146 U	0.268 U	0.262 U	0.249 U	0.22	NE

TABLE B-3
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S19-DC-19 4/04/07	S20-OC-01 4/02/07	S21-OC-02 4/02/07	S22-OC-03 4/02/07	S23-OC-04 4/02/07	S24-OC-05 4/02/07		
Aroclor 1016	0.162 U	0.162 U	0.223 U	0.287 U	0.239 U	0.254 U	3.90	NE
Aroclor 1221	0.108 U	0.108 U	0.149 U	0.192 U	0.16 U	0.17 U	3.90	NE
Aroclor 1232	0.108 U	0.108 U	0.149 U	0.192 U	0.16 U	0.17 U	3.90	NE
Aroclor 1242	0.108 U	0.108 U	0.149 U	0.192 U	0.16 U	0.17 U	0.22	NE
Aroclor 1248	0.108 U	0.108 U	0.149 U	0.192 U	0.16 U	0.17 U	0.22	NE
Aroclor 1254	0.108 U	0.172	0.484	0.468	0.458	0.332	0.22	NE
Aroclor 1260	0.129 U	0.13 U	0.178 U	0.23 U	0.192 U	0.204 U	0.22	NE

TABLE B-3
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S25-OC-06 4/02/07	S26-OC-07 4/03/07	S27-OC-08 4/03/07	S28-OC-09 4/04/07	S29-OC-10 4/04/07	S30-OC-11 4/03/07		
Aroclor 1016	0.213 U	0.209 U	0.18 U	0.156 U	0.173 U	0.23 U	3.90	NE
Aroclor 1221	0.142 U	0.139 U	0.12 U	0.104 U	0.115 U	0.153 U	3.90	NE
Aroclor 1232	0.142 U	0.139 U	0.12 U	0.104 U	0.115 U	0.153 U	3.90	NE
Aroclor 1242	0.142 U	0.139 U	0.12 U	0.104 U	0.115 U	0.153 U	0.22	NE
Aroclor 1248	0.142 U	0.139 U	0.12 U	0.104 U	0.115 U	0.153 U	0.22	NE
Aroclor 1254	0.403	0.242	0.201	0.0813 J	0.116	0.247	0.22	NE
Aroclor 1260	0.17 U	0.167 U	0.144 U	0.125 U	0.138 U	0.184 U	0.22	NE

TABLE B-3
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S31-OC-12 4/03/07	S32-OC-13 4/03/07	S33-OC-14 4/03/07	S34-OC-15 4/03/07	S35-OC-16 4/03/07	S36-OC-17 4/03/07		
Aroclor 1016	0.18 U	0.146 U	0.163 U	0.185 U	0.161 U	0.151 U	3.90	NE
Aroclor 1221	0.12 U	0.0974 U	0.109 U	0.123 U	0.108 U	0.1 U	3.90	NE
Aroclor 1232	0.12 U	0.0974 U	0.109 U	0.123 U	0.108 U	0.1 U	3.90	NE
Aroclor 1242	0.12 U	0.0974 U	0.109 U	0.123 U	0.108 U	0.1 U	0.22	NE
Aroclor 1248	0.12 U	0.0974 U	0.109 U	0.123 U	0.108 U	0.1 U	0.22	NE
Aroclor 1254	0.184	0.188	0.151	0.123 U	11.3	0.524	0.22	NE
Aroclor 1260	0.144 U	0.117 U	0.13 U	0.148 U	0.129 U	0.121 U	0.22	NE

TABLE B-3
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S37-OC-18 4/03/07	S38-OC-19 4/03/07	S39-OC-20 4/03/07	S40-OC-21 4/03/07	S41-OC-21A 4/04/07	S42-OC-22 4/03/07		
Aroclor 1016	0.159 U	0.128 U	0.134 U	0.215 U	0.162 U	0.146 U	3.90	NE
Aroclor 1221	0.106 U	0.0855 U	0.0895 U	0.144 U	0.108 U	0.0971 U	3.90	NE
Aroclor 1232	0.106 U	0.0855 U	0.0895 U	0.144 U	0.108 U	0.0971 U	3.90	NE
Aroclor 1242	0.106 U	0.0855 U	0.0895 U	0.144 U	0.108 U	0.0971 U	0.22	NE
Aroclor 1248	0.106 U	0.0855 U	0.0895 U	0.144 U	0.108 U	0.0971 U	0.22	NE
Aroclor 1254	0.179	0.145	0.257	0.197	0.166	0.161	0.22	NE
Aroclor 1260	0.127 U	0.103 U	0.107 U	0.172 U	0.129 U	0.116 U	0.22	NE

TABLE B-3
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S43-OC-23 4/03/07	S44-OC-24 4/03/07	S45-OC-25 4/03/07	S46-OC-26 4/03/07	S47-ER-EK-01 4/04/07 (micrograms per liter)	S48-ER-SH-02 4/04/07 (micrograms per liter)		
Aroclor 1016	0.145 U	0.138 U	0.176 U	0.159 U	1.22 U	1.12 U	3.90	NE
Aroclor 1221	0.097 U	0.0923 U	0.117 U	0.106 U	1.22 U	1.12 U	3.90	NE
Aroclor 1232	0.097 U	0.0923 U	0.117 U	0.106 U	1.22 U	1.12 U	3.90	NE
Aroclor 1242	0.097 U	0.0923 U	0.117 U	0.106 U	1.22 U	1.12 U	0.22	NE
Aroclor 1248	0.097 U	0.0923 U	0.117 U	0.106 U	1.22 U	1.12 U	0.22	NE
Aroclor 1254	2.42	0.0618 J	0.117 U	0.162	1.22 U	1.12 U	0.22	NE
Aroclor 1260	0.116 U	0.111 U	0.141 U	0.127 U	1.22 U	1.12 U	0.22	NE

Notes:

^a Human health reference limits taken from EPA Region 9 preliminary remediation goals (PRG) for residential soil exposure

^b Ecological reference limits were provided by EPA GLNPO

H = Estimated value. Holding time exceeded.

J = Estimated value. Greater than detection limit, but less than reporting limit.

NE = Not established

U = Not detected

Bold values exceed human health reference limits

All values are expressed in milligrams per kilogram unless otherwise noted

TABLE B-4
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S01-DC-01 4/02/07	S02-DC-02 4/02/07	S03-DC-03 4/02/07	S04-DC-04 4/02/07	S05-DC-05 4/03/07	S06-DC-06 4/03/07		
Acenaphthene	0.447 U	1.3 U	0.535 U	1.38 U	1.27 U	1.24 U	3,700	0.0098
Acenaphthylene	0.447 U	1.3 U	0.535 U	1.38 U	1.27 U	1.24 U	3,700	0.0078
Anthracene	0.076 J	1.3 U	0.112 J	1.38 U	1.27 U	0.297 J	22,000	0.0151
Benzo(a)anthracene	0.218 J	0.517 J	0.427 J	0.292 J	0.31 J	1.3	0.62	0.0132
Benzo(a)pyrene	0.183 J	0.449 J	0.305 J	0.201 J	0.201 J	1.05 J	0.062	0.0205
Benzo(b)fluoranthene	0.251 J	0.658 J	0.567	0.416 J	0.407 J	1.58	0.62	0.474
Benzo(g,h,i)perylene	0.447 R, M, LC	1.3 R, M, LC	0.535 R, M, LC	1.38 R, M, LC	1.27 R, M, LC	1.24 R, M, LC	2,300	0.0252
Benzo(k)fluoranthene	0.0734 J	0.217 J	0.212 J	1.38 U	0.155 J	0.606 J	6.2	0.0139
Chrysene	0.31 J	0.828 J	0.539	0.449 J	0.43 J	1.56	62	0.0195
Dibenz(a,h)anthracene	0.0716 J	0.149 J	0.0707 J	1.38 U	1.27 U	0.163 J	0.062	0.006
Fluoranthene	0.307 J	0.974 J	1.08	0.923 J	0.771 J	2.53	2,300	0.0505
Fluorene	0.0859 J	1.3 U	0.0728 J	1.38 U	1.27 U	0.178 J	2,700	0.0084
Indeno(1,2,3-cd)pyrene	0.103 J	0.261 J	0.216 J	0.157 J	0.135 J	0.499 J	0.62	0.0193
Naphthalene	0.384 J	0.694 J	0.131 J	0.51 J	0.692 J	0.655 J	56	0.0176
Phenanthrene	0.322 J	0.833 J	0.574	0.496 J	0.514 J	1.38	22,000	0.0234
Pyrene	0.414 J	1.08 J	0.86	0.761 J	0.593 J	2.24	2,300	0.036

TABLE B-4
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^b	Ecological Reference Limit for Sediment ^b
	S07-DC-07 4-02-07	S08-DC-08 4-02-07	S09-DC-09 4/02/07	S10-DC-10 4/03/07	S11-DC-11 4/03/07	S12-DC-12 4/03/07		
Acenaphthene	0.23 J	2.25 U	1 U	0.719 U	1.41 U	2.88 U	3,700	0.0098
Acenaphthylene	1.16 U	2.25 U	1 U	0.719 U	1.41 U	2.88 U	3,700	0.0078
Anthracene	0.374 J	2.25 U	0.275 J	0.214 J	1.41 U	2.88 U	22,000	0.0151
Benzo(a)anthracene	1.19	0.739 J	0.918 J	0.635 J	0.459 J	2.88 U	0.62	0.0132
Benzo(a)pyrene	1.05 J	0.649 J	0.898 J	0.586 J	0.428 J	2.88 U	0.062	0.0205
Benzo(b)fluoranthene	1.81	1.32 J	1.48	1.1	0.853 J	0.306 J	0.62	0.474
Benzo(g,h,i)perylene	1.16 R, M, LC	2.25 R, M, LC	1 R, M, LC	0.719 R, M, LC	1.41 R, M, LC	2.88 R, M, LC, CV	2,300	0.0252
Benzo(k)fluoranthene	0.599 J	0.419 J	0.519 J	0.394 J	0.293 J	2.88 U	6.2	0.0139
Chrysene	1.53	1.1 J	1.24	0.949	0.693 J	2.88 U	62	0.0195
Dibenz(a,h)anthracene	0.169 J	2.25 U	0.136 J	0.0907 J	1.41 U	2.88 U	0.062	0.006
Fluoranthene	2.81	2.6	2.76	2.23	1.41	0.473 J	2,300	0.0505
Fluorene	0.234 J	2.25 U	0.136 J	0.132 J	0.217 J	2.88 U	2,700	0.0084
Indeno(1,2,3-cd)pyrene	0.627 J	0.478 J	0.547 J	0.396 J	0.27 J	2.88 U	0.62	0.0193
Naphthalene	0.928 J	2.25 U	1 U	0.719 U	1.41 U	2.88 U	56	0.0176
Phenanthrene	1.26	1.25 J	1.15	1.1	1.55	2.88 U	22,000	0.0234
Pyrene	2.26	1.79 J	2	1.64	1.08 J	0.317 J	2,300	0.036

TABLE B-4
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S13-DC-13 4/04/07	S14-DC-14 4/04/07	S15-DC-15 4/04/07	S16-DC-16 4/02/07	S17-DC-17 4/02/07	S18-DC-18 4/02/07		
Acenaphthene	0.394 J	5.85	0.515 U	1.25 U	1.25 U	1.27 U	3,700	0.0098
Acenaphthylene	0.859 U	0.816 J	0.515 U	1.25 U	1.25 U	1.27 U	3,700	0.0078
Anthracene	1.54	32.4	0.515 U	0.341 J	0.171 J	1.27 U	22,000	0.0151
Benzo(a)anthracene	5.3	87.2	0.0712 J	1.69	0.934 J	0.894 J	0.62	0.0132
Benzo(a)pyrene	5.4	82.5	0.0712 J	1.7	1.02 J	0.894 J	0.062	0.0205
Benzo(b)fluoranthene	7.65	10.7	0.105 J	2.75	1.68	1.47	0.62	0.474
Benzo(g,h,i)perylene	0.859 R, M, LC, CV	2.53 R, M, LC, CV	0.515 R, M, LC, CV	1.25 R, M, LC, CV	1.25 R, M, LC, CV	1.27 R, M, LC, CV	2,300	0.0252
Benzo(k)fluoranthene	2.63	38.6	0.515 U	0.964 J	0.583 J	0.531 J	6.2	0.0139
Chrysene	5.1	80.9	0.0898 J	1.71	1.03 J	0.901 J	62	0.0195
Dibenz(a,h)anthracene	0.659 J	9.74	0.515 U	0.208 J	1.25 U	1.27 U	0.062	0.006
Fluoranthene	10.8	190	0.182 J	4.1	2.3	2.09	2,300	0.0505
Fluorene	0.619 J	8.72	0.515 U	1.25 U	1.25 U	1.27 U	2,700	0.0084
Indeno(1,2,3-cd)pyrene	2.35	32.9	0.515 U	0.811 J	0.492 J	0.406 J	0.62	0.0193
Naphthalene	0.253 J	1.93 J	0.515 U	1.25 U	1.25 U	1.27 U	56	0.0176
Phenanthrene	4.31	68.4	0.063 J	1.13 J	0.595 J	0.584 J	22,000	0.0234
Pyrene	8.99	150	0.141 J	2.96	1.67	1.63	2,300	0.036

TABLE B-4
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S19-DC-19 4/04/07	S20-OC-01 4/02/07	S21-OC-02 4/02/07	S22-OC-03 4/02/07	S23-OC-04 4/02/07	S24-OC-05 4/02/07		
Acenaphthene	0.578 U	0.646 U	0.744 U	1 U	0.725 U, H	0.785 U, H	3,700	0.0098
Acenaphthylene	0.578 U	0.646 U	0.744 U	1 U	0.725 U, H	0.785 U, H	3,700	0.0078
Anthracene	0.578 U	0.142 J	0.336 J	0.227 J	0.277 J, H	0.329 J, H	22,000	0.0151
Benzo(a)anthracene	0.147 J	0.727	1.12	0.761 J	0.666 J, H	0.872 H	0.62	0.0132
Benzo(a)pyrene	0.11 J	0.725	1.15	0.888 J	0.551 J, H	1.21 H	0.062	0.0205
Benzo(b)fluoranthene	0.186 J	1.06	2.24	1.59	0.913 H	2.27 H	0.62	0.474
Benzo(g,h,i)perylene	0.578 R, M, LC, CV	0.646 R, M, LC, CV	0.744 R, LC, CV	1 R, M, LC, CV	0.373 R, H, LC	0.83 R, H, LC	2,300	0.0252
Benzo(k)fluoranthene	0.0717 J	0.202 J	0.472 J	0.442 J	0.297 J, H	0.745 J, H	6.2	0.0139
Chrysene	0.103 J	1.92	2.5	1.77	1.31 H	1.76 H	62	0.0195
Dibenz(a,h)anthracene	0.578 U	0.219 J	0.146 J	0.141 J	0.107 J, H	0.176 J, H	0.062	0.006
Fluoranthene	0.25 J	0.641 J	1.86	1.92	1.39 H	2.94 H	2,300	0.0505
Fluorene	0.578 U	0.125 J	0.247 J	0.163 J	0.225 J, H	0.303 J, H	2,700	0.0084
Indeno(1,2,3-cd)pyrene	0.578 U	0.233 J	0.293 J	0.311 J	0.29 J, H	0.711 J, H	0.62	0.0193
Naphthalene	0.578 U	0.173 J	0.517 J	0.42 J	0.562 J, H	0.283 J, H	56	0.0176
Phenanthrene	0.0752 J	0.862	1.45	1.13	1.13 H	1.13 H	22,000	0.0234
Pyrene	0.182 J	1.14	2.7	2.02	1.99 H	2.57 H	2,300	0.036

TABLE B-4
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S25-OC-06 4/02/07	S26-OC-07 4/03/07	S27-OC-08 4/03/07	S28-OC-09 4/04/07	S29-OC-10 4/04/07	S30-OC-11 4/03/07		
Acenaphthene	0.628 U, H	0.662 U, H	0.513 U, H	<i>1.33 H</i>	0.539 U, H	0.571 U, H	3,700	0.0098
Acenaphthylene	0.628 U, H	0.662 U, H	0.513 U, H	0.44 U, H	0.539 U, H	0.571 U, H	3,700	0.0078
Anthracene	<i>0.151 J, H</i>	<i>0.208 J, H</i>	<i>0.351 J, H</i>	<i>3.8 H</i>	<i>0.326 J, H</i>	<i>0.344 J, H</i>	22,000	0.0151
Benzo(a)anthracene	<i>0.305 J, H</i>	<i>0.783 H</i>	<i>0.719 H</i>	<i>10.9 H</i>	<i>1.08 H</i>	<i>1.77 H</i>	0.62	0.0132
Benzo(a)pyrene	<i>0.294 J, H</i>	<i>0.865 H</i>	<i>0.759 H</i>	<i>7.86 H</i>	<i>1.29 H</i>	<i>2.39 H</i>	0.062	0.0205
Benzo(b)fluoranthene	<i>0.427 J, H</i>	<i>1.47 H</i>	<i>1.09 H</i>	<i>14 H</i>	<i>2.25 H</i>	<i>4.31 H</i>	0.62	0.474
Benzo(g,h,i)perylene	0.148 R, H, LC	0.474 R, H, LC	0.325 R, H, LC	1.92 R, H, LC	0.495 R, H, LC, CV		2,300	0.0252
Benzo(k)fluoranthene	<i>0.151 J, H</i>	<i>0.46 J, H</i>	<i>0.397 J, H</i>	<i>3.63 H</i>	<i>0.8 H</i>	<i>1.38 H</i>	6.2	0.0139
Chrysene	<i>0.586 J, H</i>	<i>1.24 H</i>	<i>1.12 H</i>	<i>12.4 H</i>	<i>1.84 H</i>	<i>3.11 H</i>	62	0.0195
Dibenz(a,h)anthracene	0.628 U, H	<i>0.124 J, H</i>	<i>0.0945 J, H</i>	<i>0.951 H</i>	<i>0.13 J, H</i>	<i>0.238 J, H</i>	0.062	0.006
Fluoranthene	<i>0.743 H</i>	<i>1.82 H</i>	<i>1.55 H</i>	<i>18 H</i>	<i>3.19 H</i>	<i>5.87 H</i>	2,300	0.0505
Fluorene	<i>0.123 J, H</i>	<i>0.142 J, H</i>	<i>0.148 J, H</i>	<i>1.5 H</i>	<i>0.0799 J, H</i>	<i>0.146 J, H</i>	2,700	0.0084
Indeno(1,2,3-cd)pyrene	<i>0.111 J, H</i>	<i>0.396 J, H</i>	<i>0.299 J, H</i>	<i>2.11 H</i>	<i>0.509 H, CV</i>	<i>0.914 J, H, CV</i>	0.62	0.0193
Naphthalene	<i>0.162 J, H</i>	0.662 U, H	<i>0.176 J, H</i>	<i>0.311 J, H</i>	0.539 U, H	0.751 U, H	56	0.0176
Phenanthrene	<i>0.501 J, H</i>	<i>0.824 H</i>	<i>0.709 H</i>	<i>13.1 H</i>	<i>2.81 H</i>	<i>4.84 H</i>	22,000	0.0234
Pyrene	<i>1.16 H</i>	<i>1.89 H</i>	<i>1.93 H</i>	<i>17.4 H</i>	<i>4.55 H</i>	<i>3.82 H</i>	2,300	0.036

TABLE B-4
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S31-OC-12 4/03/07	S32-OC-13 4/03/07	S33-OC-14 4/03/07	S34-OC-15 4/03/07	S35-OC-16 4/03/07	S36-OC-17 4/03/07		
Acenaphthene	0.726 U	0.532 U	0.586 U	0.121 J	0.748	1.15	3,700	0.0098
Acenaphthylene	0.726 U	0.532 U	0.11 J	0.527 U	0.5 U	0.235 J	3,700	0.0078
Anthracene	0.295 J	0.291 J	0.29 J	0.316 J	1.34	2.6	22,000	0.0151
Benzo(a)anthracene	1.26	0.891	1.43	1.26	3.49	7.13	0.62	0.0132
Benzo(a)pyrene	1.66	0.983	1.58	1.38	2.51	7.22	0.062	0.0205
Benzo(b)fluoranthene	3.76	2.15	2.52	2.44	2.86	9.52	0.62	0.474
Benzo(g,h,i)perylene	0.726 R, M, LC, CV	0.532 R, M, LC, CV	0.586 R, M, LC, CV	0.527 R, LC	0.441 R, J, LC	2.22 R, LC	2,300	0.0252
Benzo(k)fluoranthene	1.26	0.695	0.969	0.789	0.788	3.09	6.2	0.0139
Chrysene	2.22	1.57	2.26	1.83	4.37	8.81	62	0.0195
Dibenz(a,h)anthracene	0.726 U, CV	0.532 U, CV	0.45 J, CV	0.191 J	0.0892 J	1.81	0.062	0.006
Fluoranthene	4.61	2.69	3.46	3.14	3.34	19.1	2,300	0.0505
Fluorene	0.119 J	0.532 U	0.118 J	0.156 J	0.546	1.5	2,700	0.0084
Indeno(1,2,3-cd)pyrene	0.469 J, CV	0.245 J, CV	1.73 CV	0.787	1.28	5.58	0.62	0.0193
Naphthalene	0.726 U	0.113 J	0.109 J	0.495 J	0.313 J	1.45	56	0.0176
Phenanthrene	1.53	0.668	1.41	1.69	1.85	13.6	22,000	0.0234
Pyrene	3.09	2.33	3.87	2.59	13	17.8	2,300	0.036

TABLE B-4
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S37-OC-18 4/03/07	S38-OC-19 4/03/07	S39-OC-20 4/03/07	S40-OC-21 4/03/07	S41-OC-21A 4/04/07	S42-OC-22 4/03/07		
Acenaphthene	<i>0.643 J</i>	<i>0.18 J</i>	<i>0.723</i>	0.846 U	0.692 U	<i>1.63</i>	3,700	0.0098
Acenaphthylene	1.08 U	0.416 U	<i>0.203 J</i>	0.846 U	0.692 U	1.25 U	3,700	0.0078
Anthracene	<i>2.05</i>	<i>0.297 J</i>	<i>1.81</i>	<i>0.232 J</i>	<i>0.123 J</i>	<i>4.84</i>	22,000	0.0151
Benzo(a)anthracene	<i>3.46</i>	<i>1.02</i>	<i>6.79</i>	<i>1.38</i>	<i>0.598 J</i>	<i>18.4</i>	0.62	0.0132
Benzo(a)pyrene	<i>3.27</i>	<i>1.13</i>	<i>6.95</i>	<i>1.84</i>	<i>0.773</i>	<i>20</i>	0.062	0.0205
Benzo(b)fluoranthene	<i>4.08</i>	<i>1.67</i>	<i>9.88</i>	<i>2.67</i>	<i>1.32</i>	<i>24.7</i>	0.62	0.474
Benzo(g,h,i)perylene	0.879 R, J, LC	0.144 R, J, LC	1.04 R, LC	0.648 R, J, LC	0.114 R, J, LC	8.39 R, LC	2,300	0.0252
Benzo(k)fluoranthene	<i>1.4</i>	<i>0.585</i>	<i>3.08</i>	<i>0.911</i>	<i>0.425 J</i>	<i>7.88</i>	6.2	0.0139
Chrysene	<i>3.95</i>	<i>1.34</i>	<i>7.84</i>	<i>2.27</i>	<i>0.969</i>	<i>22.9</i>	62	0.0195
Dibenz(a,h)anthracene	<i>0.855 J</i>	<i>0.174 J</i>	<i>1.01</i>	<i>0.581 J</i>	<i>0.136 J</i>	<i>4.53</i>	0.062	0.006
Fluoranthene	<i>8.79</i>	<i>2.92</i>	<i>19.5</i>	<i>3.58</i>	<i>1.9</i>	<i>51.8</i>	2,300	0.0505
Fluorene	<i>0.859 J</i>	<i>0.231 J</i>	<i>0.982</i>	0.846 U	0.692 U	<i>2.39</i>	2,700	0.0084
Indeno(1,2,3-cd)pyrene	<i>2.5</i>	<i>0.679</i>	<i>3.74</i>	<i>1.81</i>	<i>0.517 J</i>	<i>17.7</i>	0.62	0.0193
Naphthalene	<i>0.459 J</i>	<i>0.824</i>	<i>0.288 J</i>	0.846 U	0.692 U	<i>0.265 J</i>	56	0.0176
Phenanthrene	<i>6.93</i>	<i>1.67</i>	<i>12.4</i>	<i>1.34</i>	<i>0.645 J</i>	<i>26.3</i>	22,000	0.0234
Pyrene	<i>8.59</i>	<i>2.25</i>	<i>17.3</i>	<i>3.54</i>	<i>1.54</i>	<i>44.8</i>	2,300	0.036

TABLE B-4
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil ^a	Ecological Reference Limit for Sediment ^b
	S43-OC-23 4/03/07	S44-OC-24 4/03/07	S45-OC-25 4/03/07	S46-OC-26 4/03/07	S47-ER-EK-01 4/04/07 (micrograms per liter)	S47-ER-SH-02 4/04/07 (micrograms per liter)		
Acenaphthene	0.655 U	0.509 U	0.641 U	0.599 U	5.26 U, H	5.15 U, H	3,700	0.0098
Acenaphthylene	0.655 U	0.509 U	0.641 U	0.599 U	5.26 U, H	5.15 U, H	3,700	0.0078
Anthracene	<i>0.168 J</i>	<i>0.109 J</i>	<i>0.162 J</i>	<i>0.368 J</i>	5.26 U, H	5.15 U, H	22,000	0.0151
Benzo(a)anthracene	<i>0.539 J</i>	<i>0.375 J</i>	0.704	1.47	5.26 U, H	5.15 U, H	0.62	0.0132
Benzo(a)pyrene	0.46 J	0.364 J	0.672	1.62	5.26 U, H	5.15 U, H	0.062	0.0205
Benzo(b)fluoranthene	<i>0.56 J</i>	<i>0.521</i>	1.09	2.64	5.26 U, H	5.15 U, H	0.62	0.474
Benzo(g,h,i)perylene	0.08 R, J, LC	0.125 R, J, LC	0.214 R, J, LC	0.173 R, J, LC	5.26 U, H	5.15 U, H	2,300	0.0252
Benzo(k)fluoranthene	<i>0.142 J</i>	<i>0.198 J</i>	<i>0.373 J</i>	<i>0.865</i>	5.26 U, H	5.15 U, H	6.2	0.0139
Chrysene	<i>1.15</i>	<i>0.478 J</i>	<i>0.922</i>	<i>2.01</i>	5.26 U, H	5.15 U, H	62	0.0195
Dibenz(a,h)anthracene	0.147 J	0.158 J	0.254 J	0.217 J	5.26 U, H	5.15 U, H	0.062	0.006
Fluoranthene	<i>0.982</i>	<i>0.869</i>	<i>1.52</i>	<i>4.97</i>	5.26 U, H	5.15 U, H	2,300	0.0505
Fluorene	<i>0.113 J</i>	<i>0.15 J</i>	0.641 U	<i>0.145 J</i>	5.26 U, H	5.15 U, H	2,700	0.0084
Indeno(1,2,3-cd)pyrene	<i>0.388 J</i>	<i>0.382 J</i>	0.643	0.853	5.26 U, H	5.15 U, H	0.62	0.0193
Naphthalene	0.655 U	<i>0.136 J</i>	<i>0.168 J</i>	0.599 U	5.26 U, H	5.15 U, H	56	0.0176
Phenanthrene	<i>0.761</i>	<i>0.585</i>	<i>0.571 J</i>	<i>2.11</i>	5.26 U, H	5.15 U, H	22,000	0.0234
Pyrene	<i>1.35</i>	<i>0.874</i>	<i>1.47</i>	<i>3.66</i>	5.26 U, H	5.15 U, H	2,300	0.036

Notes:

^a Human health reference limits taken from EPA Region 9 preliminary remediation goals (PRG) for residential soil exposure

^b Ecological reference limits were provided by EPA GLNPO

CV = Estimated value. Calibration verification results exceed upper or lower control limits.

H = Estimated value. Holding time exceeded.

J = Estimated value. Greater than detection limit, but less than reporting limit.

LC = Estimated value. Laboratory control recoveries exceed upper or lower control limits.

M = Estimated value. Associated matrix spike/matrix spike duplicate recoveries exceed the upper or lower control limits.

R = Rejected value

U = Analyte not detected at or above reporting limit.

Bold values exceed human health reference limits

Italicized values exceed ecological reference limits

All values expressed in milligrams per kilogram unless otherwise noted

TABLE B-5
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL GREASE
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil	Ecological Reference Limit for Sediment
	S01-DC-01 4/02/07	S02-DC-02 4/02/07	S03-DC-03 4/02/07	S04-DC-04 4/02/07	S05-DC-05 4/03/07	S06-DC-06 4/03/07		
Arsenic	45.5	46.8	5.48	102	132	42.2	0.39	0.715
Barium	94.9	439	133	526	469	343	5,400	NE
Cadmium	0.83	5	0.49	4.58	4.49	2.35	37	0.0991
Chromium	26	81.9	15.9	77.4	76.2	66	100,000	2.02
Lead	112	292	83.6	402	290	240	400	3.53
Mercury	0.05 U,B	0.19 J	0.37	0.23	0.19	0.13	23	0.0158
Selenium	2.21 U	5.56	2.45 U	9.6	9.97	6.07	390	NE
Silver	1.4 U	2.9 U	1.4 U	3.1 U	2.9 U	2.6 U	390	0.044
Total Organic Carbon (%)	8.56 H, LD	11.1 H, LD	4.86 H, LD	7.15 H, LD	12.2 H, LD	6.24 H, LD	NE	NE
Oil & Grease	1100 J	2130 J	2390 J	6360 U	3400 J	2740 J	NE	NE

TABLE B-5
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL GREASE
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil	Ecological Reference Limit for Sediment
	S07-DC-07 4-02-07	S08-DC-08 4-02-07	S09-DC-09 4/02/07	S10-DC-10 4/03/07	S11-DC-11 4/03/07	S12-DC-12 4/03/07		
Arsenic	72.2	65.1	41.3	29.5	140	82.3	0.39	0.715
Barium	447	651	324	295	651	2,152	5,400	NE
Cadmium	<i>3.51</i>	<i>3.67</i>	<i>2.24</i>	<i>1.66</i>	<i>3.39</i>	<i>16.08</i>	37	0.0991
Chromium	72.2	74.4	44.2	38.6	65.1	190	100,000	2.02
Lead	309	363	186	173	277	1,076	400	3.53
Mercury	<i>0.21 J</i>	<i>0.18 J</i>	<i>0.21 J</i>	<i>0.12 J</i>	<i>0.13 J</i>	6.82	23	0.0158
Selenium	7.56	7.44 U	4.72 U	3.86 U	7.19	30.4	390	NE
Silver	<i>44.7</i>	4.6 U	2.9 U	2.3 U	3.4 U	<i>10.8</i>	390	0.044
Total Organic Carbon (%)	15.8 H, LD	7.48 H, LD	28.7 H, LD	5.93 H, LD	7.33 H, LD	26.7 H, LD	NE	NE
Oil & Grease	7600 U	4050 J	3770 J	4060 U	4790 J	13900 U	NE	NE

TABLE B-5
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL GREASE
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil	Ecological Reference Limit for Sediment
	S13-DC-13 4/04/07	S14-DC-14 4/04/07	S15-DC-15 4/04/07	S16-DC-16 4/02/07	S17-DC-17 4/02/07	S18-DC-18 4/02/07		
Arsenic	22.9	86	52.1	129	125	121	0.39	0.715
Barium	159	315	68.4	514	492	455	5,400	NE
Cadmium	<i>0.88</i>	<i>1.23</i>	<i>0.37</i>	<i>3.12</i>	<i>3.34</i>	<i>3.42</i>	37	0.0991
Chromium	<i>33.5</i>	<i>31.5</i>	<i>21.2</i>	<i>109</i>	<i>121</i>	<i>100</i>	100,000	2.02
Lead	<i>108</i>	<i>226</i>	<i>78.2</i>	<i>354</i>	<i>393</i>	<i>333</i>	400	3.53
Mercury	0.03 U, B	<i>0.08 J</i>	0.02 U, B	<i>0.11 J</i>	<i>0.12 J</i>	<i>0.11 J</i>	23	0.0158
Selenium	2.82 U	15.5	3.26	18	18.7	16.7	390	NE
Silver	1.8 U	2.9 U	1.6 U	3.2 U	3.3 U	3 U	390	0.044
Total Organic Carbon (%)	5.09 H, LD	10.5 H, LD	2.96 H, LD	3.33 H, LD	4 H, LD	2.56 H, LD	NE	NE
Oil & Grease	1340 J	12600	3040 U	6840 U	6370 U	5610 U	NE	NE

TABLE B-5
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL GREASE
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil	Ecological Reference Limit for Sediment
	S19-DC-19 4/04/07	S20-OC-01 4/02/07	S21-OC-02 4/02/07	S22-OC-03 4/02/07	S23-OC-04 4/02/07	S24-OC-05 4/02/07		
Arsenic	54.1	12.9	32.5	43.1	29.4	35.7	0.39	0.715
Barium	97.1	86.6	346	350	385	286	5,400	NE
Cadmium	<i>0.4</i>	<i>0.9</i>	<i>2.29</i>	<i>2.67</i>	<i>1.97</i>	<i>2.55</i>	37	0.0991
Chromium	<i>19.1</i>	<i>56.2</i>	<i>177</i>	<i>224</i>	<i>385</i>	<i>162</i>	100,000	2.02
Lead	<i>68.5</i>	<i>89.7</i>	<i>260</i>	<i>350</i>	<i>294</i>	<i>333</i>	400	3.53
Mercury	0.04 U, B	<i>0.1 J</i>	<i>0.3</i>	<i>0.28</i>	<i>0.35</i>	<i>0.25</i>	23	0.0158
Selenium	4.46	2.43 U	3.46 U	4.31 U	7.24 U	3.81 U	390	NE
Silver	1.6 U	1.5 U	2.2 U	2.7 U	2.3 U	2.4 U	390	0.044
Total Organic Carbon (%)	2.72 H, LD	1.47 H, LD	7.44 H, LD	5.03 H, LD	4.81 H, LD	6.39 H, LD	NE	NE
Oil & Grease	3200 U	2730 U	7840	6290	13100	4220 J	NE	NE

TABLE B-5
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL GREASE
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil	Ecological Reference Limit for Sediment
	S25-OC-06 4/02/07	S26-OC-07 4/03/07	S27-OC-08 4/03/07	S28-OC-09 4/04/07	S29-OC-10 4/04/07	S30-OC-11 4/03/07		
Arsenic	26.5	38.1	27.3	22.5	39.5	52.5	0.39	0.715
Barium	265	220	150	127	189	284	5,400	NE
Cadmium	<i>1.37</i>	<i>1.82</i>	<i>0.87</i>	<i>0.9</i>	<i>1.51</i>	<i>2.6</i>	37	0.0991
Chromium	<i>186</i>	220	<i>121</i>	<i>89.8</i>	<i>127</i>	<i>160</i>	100,000	2.02
Lead	<i>204</i>	<i>321</i>	<i>187</i>	<i>165</i>	<i>206</i>	<i>306</i>	400	3.53
Mercury	<i>0.26</i>	<i>0.35</i>	<i>0.22</i>	<i>0.28</i>	<i>0.2</i>	<i>0.28</i>	23	0.0158
Selenium	6.73 U	6.41 U	5.62 U	2.4 U	2.74 U	3.72 U	390	NE
Silver	2 U	2 U	1.7 U	1.5 U	1.7 U	2.2 U	390	0.044
Total Organic Carbon (%)	4.56 H, LD	7.16 H, LD	2.94 H, LD	2.48 H, LD	10.1 H, LD	5.45 H, LD	NE	NE
Oil & Grease	5110	3050 J	2000 J	3120 U	1390 J	2040 J	NE	NE

TABLE B-5
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL GREASE
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil	Ecological Reference Limit for Sediment
	S31-OC-12 4/03/07	S32-OC-13 4/03/07	S33-OC-14 4/03/07	S34-OC-15 4/03/07	S35-OC-16 4/03/07	S36-OC-17 4/03/07		
Arsenic	54.1	42.1	55	83.5	46.3	58.5	0.39	0.715
Barium	192	129	336	301	255	190	5,400	NE
Cadmium	<i>1.69</i>	<i>1.3</i>	<i>1.77</i>	<i>1.65</i>	<i>1.12</i>	<i>1.68</i>	37	0.0991
Chromium	279	323	153	184	399	237	100,000	2.02
Lead	262	196	397	267	191	237	400	3.53
Mercury	<i>0.2</i>	<i>0.15</i>	<i>0.11 J</i>	<i>0.14</i>	<i>0.77</i>	<i>0.17</i>	23	0.0158
Selenium	3.14	3.65	2.44 U	2.67	5.1 U	3.01	390	NE
Silver	1.7 U	1.4 U	1.5 U	1.7 U	1.6 U	1.6 U	390	0.044
Total Organic Carbon (%)	5.46 H, LD	3.42 H, LD	2.48 H, LD	4.62 H, LD	4.12 H, LD	4.96 H, LD	NE	NE
Oil & Grease	1940 J	7460	3350	12500	13000	3910	NE	NE

TABLE B-5
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL GREASE
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil	Ecological Reference Limit for Sediment
	S37-OC-18 4/03/07	S38-OC-19 4/03/07	S39-OC-20 4/03/07	S40-OC-21 4/03/07	S41-OC-21A 4/04/07	S42-OC-22 4/03/07		
Arsenic	35.8	34.8	47.3	65.7	56.6	17.4	0.39	0.715
Barium	156	94.2	143	318	137	155	5,400	NE
Cadmium	<i>1.06</i>	<i>0.53</i>	<i>1.23</i>	<i>1.48</i>	<i>1.09</i>	<i>2.39</i>	37	0.0991
Chromium	218	<i>76.1</i>	<i>103</i>	<i>106</i>	<i>56.6</i>	<i>98.1</i>	100,000	2.02
Lead	202	<i>69.7</i>	<i>207</i>	<i>206</i>	<i>102</i>	<i>348</i>	400	3.53
Mercury	<i>0.25</i>	0.06 U, B	<i>0.11</i>	<i>0.12 J</i>	<i>0.15</i>	0.08 U, B	23	0.0158
Selenium	2.65 U	2.06 U	2.36 U	3.39 U	2.92 U	5.22 U	390	NE
Silver	1.6 U	1.3 U	1.5 U	2.1 U	1.8 U	1.6 U	390	0.044
Total Organic Carbon (%)	4.38 H, LD	1.39 H, LD	2.63 H, LD	5.51 H, LD	3.4 H, LD	5.51 H, LD	NE	NE
Oil & Grease	2470 J	1550 J	2740 J	1720 J	1750 J	9120	NE	NE

TABLE B-5
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL GREASE
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected						Human Health Reference Limit for Soil	Ecological Reference Limit for Sediment
	S43-OC-23 4/03/07	S44-OC-24 4/03/07	S45-OC-25 4/03/07	S46-OC-26 4/03/07	S47-ER-EK-01 4/04/07 (milligrams per liter)	S47-ER-SH-02 4/04/07 (milligrams per liter)		
Arsenic	51	6.67	25.8	23.8	0.02 U	0.02 U	0.39	0.715
Barium	117	62.4	207	221	0.003 U	0.003 U	5,400	NE
Cadmium	<i>0.8</i>	<i>0.51</i>	<i>1.46</i>	<i>1.48</i>	0.002 U	0.002 U	37	0.0991
Chromium	42.5	28.4	34.4	44.1	0.005 U	0.005 U	100,000	2.02
Lead	78.2	66.7	105	144	0.015 U	0.015 U	400	3.53
Mercury	<i>0.12 J</i>	<i>0.21</i>	<i>0.08 J</i>	0.07 U,B	0.0005 U	0.0005 U	23	0.0158
Selenium	2.72 U	2.27 U	2.75 U	2.72 U	0.03 U	0.03 U	390	NE
Silver	1.7 U	1.4 U	1.7 U	1.7 U	0.005 U	0.005 U	390	0.044
Total Organic Carbon (%)	3.07 H, LD	1.85 H, LD	13.2 H, LD	2.61 H, LD	1.9 J	1.4 J	NE	NE
Oil & Grease	4160	2900	1560 J	2530 J	NA	1.8 U	NE	NE

Notes:

^a Human health reference limits taken from EPA Region 9 preliminary remediation goals (PRG) for residential soil exposure (EPA 2004c).

^b Ecological reference limits were provided by EPA GLNPO (MacDonald and others 2005).

% = Percent

B = Analyte detected in laboratory method blank.

H = Estimated value. Holding time exceeded.

J = Estimated value. Greater than detection limit, but less than reporting limit.

LD = Estimated value. Batch quality control for lab duplicate exceeds upper or lower control limits.

M = Estimated value. Associated MS/MSD recoveries exceed the upper or lower control limits.

MS = Estimated value. RPD between MS/MSD exceeded specified criteria.

NA = Not analyzed

NE = Not established

R = Value is rejected

U = Analyte not detected at or above reporting limit.

Bold values exceed ecological and human health reference limits

Italicized values exceed ecological reference limits

All values expressed in milligrams per kilogram unless otherwise noted

TABLE B-6
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - FULL-SCAN PAHs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected							
	S01-DC-01 4/02/07	S03-DC-03 4/02/07	S05-DC-05 4/03/07	S08-DC-08 4-02-07	S10-DC-10 4/03/07	S13-DC-13 4/04/07	S14-DC-14 4/04/07	S20-OC-01 4/02/07
Acenaphthene	0.041 IS	0.028 J, IS	0.42 IS	0.099 J, IS	0.12 U	0.19 U	10	0.079 U
Acenaphthylene	0.015 J, IS	0.011 J, IS	0.026 J, IS	0.022 J, IS	0.12 U	0.19 U	9.5 U	0.079 U
Anthracene	0.1 IS	0.15 IS	0.15 IS	0.32 IS	0.24	0.59	57	0.11
Benzo(a)anthracene	0.45 IS	0.68 IS	0.63 IS	1.3 IS	1.1	2.1	180	1.3
Benzo(a)pyrene	0.55 IS	0.69 IS	0.61 IS	1.3 IS	1.2	2.1	140	1.4
Benzo(b)fluoranthene	0.57 IS	0.77 IS	0.81 IS	2.1 IS	1.9	2.4	150	1.8
Benzo(e)pyrene	0.52 IS	0.47 IS	0.52 IS	1.1 IS	0.95	1.2	77	2.1
Benzo(g,h,i)perylene	0.54 IS	0.55 IS	0.49 IS	1.2 IS	1	1.4	76	1.4
Benzo(k)fluoranthene	0.24 IS	0.64 IS	0.66 IS	1.4 IS	1.3	2	130	0.46
C1-Chrysene	1.2 IS	0.45 IS	0.94 IS	1 IS	0.76	1	61	4
C1-Fluorenes	0.15 IS	0.038 J, IS	0.66 IS	0.05 J, IS	0.12 U	0.19 U	9.5 U	0.36
C1-Fluoranthenes/pyrene	0.8 IS	0.59 IS	0.61 IS	1 IS	0.91	1.4	100	2.9
C1-Naphthalenes	0.55 IS	0.09 IS	0.3 IS	0.079 J, IS	0.12 U	0.19 U	9.5 U	0.2
C1-Phenanthrenes/anthracenes	0.9 IS	0.39 IS	0.52 IS	0.66 IS	0.39	0.88	61	2
C2-Chrysene	1 IS	0.28 IS	0.74 IS	0.34 IS	0.29	0.31	17	3.2
C2-Fluorenes	0.28 IS	0.064 IS	0.14 IS	0.052 J, IS	0.12 U	0.19	9.5 U	0.77
C2-Naphthalenes	1.9 IS	0.35 IS	0.89 IS	0.25 IS	0.13	1.3	16	1.7
C2-Phenanthrenes/anthracenes	0.79 IS	0.25 IS	0.46 IS	0.29 IS	0.21	0.39	19	2.2
C3-Chrysene	0.42 IS	0.12 IS	0.51 IS	0.11 J, IS	0.12 U	0.19 U	9.5 U	1.4
C3-Fluorenes	0.53 IS	0.12 IS	0.35 IS	0.088 J, IS	0.12 U	0.19	9.5 U	1.6
C3-Naphthalenes	1.6 IS	0.37 IS	0.74 IS	0.16 IS	0.12 U	1.5	16	3.6
C3-Phenanthrenes/anthracenes	0.6 IS	0.18 IS	0.47 IS	0.15 IS	0.12 U	0.19 U	9.5 U	2
C4-Chrysene	0.17 IS	0.055 IS	0.35 IS	0.048 J, IS	0.12 U	0.19 U	9.5 U	7
C4-Naphthalenes	1.3 IS	0.25 IS	0.62 IS	0.12 IS	0.12 U	1.1	12	3.1
C4-Phenanthrenes/anthracenes	0.24 IS	0.064 IS	0.35 IS	0.049 J, IS	0.12 U	0.19 U	9.5 U	1.1
Chrysene	0.67 IS	0.84 IS	0.83 IS	1.9 IS	1.5	2.2	160	3
Dibenz(a,h)anthracene	0.19 IS	0.15 IS	0.15 IS	0.31 IS	0.28	0.31	18	0.72
Fluoranthene	0.63 IS	2 IS	1.2 IS	4.4 IS	3.4	5.3	440	1
Fluorene	0.081 IS	0.063 IS	0.71 IS	0.19 IS	0.12 U	0.2	15	0.13
Indeno(1,2,3-cd)pyrene	0.28 IS	0.48 IS	0.46 IS	1.1 IS	1	1.3	78	0.76
Naphthalene	0.22 IS	0.067 IS	0.27 IS	0.066 J, IS	0.12 U	0.19 U	9.5 U	0.079 U
Perylene	0.12 IS	0.17 IS	0.17 IS	0.33	0.32	0.57	35	0.25
Phenanthrene	0.43 IS	0.73 IS	0.48 IS	1.4	0.99	1.5	140	0.71
Pyrene	0.82 IS	1.5 IS	1.1 IS	3.2 IS	2.5	4	330	2

TABLE B-6
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - FULL-SCAN PAHs
DUCK AND OTTER CREEKS
TOLEDO, OHIO

Parameter	Sample Number and Date Collected							
	S22-OC-03 4/02/07	S24-OC-05 4/02/07	S26-OC-07 4/03/07	S30-OC-11 4/03/07	S33-OC-14 4/03/07	S38-OC-19 4/03/07	S42-OC-22 4/03/07	S46-OC-26 4/03/07
Acenaphthene	0.079 J	0.12 U	0.14	0.19 U	0.12 U	0.22	1.5 U	0.18 U
Acenaphthylene	0.03 J	0.12 U	0.12 U	0.19 U	0.12 U	0.12 U	1.5 U	0.18 U
Anthracene	0.23	0.14	0.24	0.33	0.27	0.76	3.8	0.36
Benzo(a)anthracene	2.6	1.2	1.8	2	1.6	2.1	17	1.7
Benzo(a)pyrene	3.2	1.7	1.9	2.6	1.8	2	19	1.7
Benzo(b)flouranthene	3.7	2.6	1.9	3.8	2.7	2.4	26	2.5
Benzo(e)pyrene	3.7	1.6	2	2.1	1.5	1.3	13	1.2
Benzo(g,h,i)perylene	3	1.8	1.5	2.4	1.6	1.4	15	1.4
Benzo(k)flouranthene	3	2.1	1.8	2.7	2	1.8	18	1.8
C1-Chrysene	7.8	1.8	6.6	2	1.3	0.98	7.2	0.75
C1-Florenes	0.35	0.45	0.45	0.27	0.12	0.12 U	1.5 U	0.18 U
C1-Flouran/Pyrenes	7.7	2.2	7.1	3	1.7	1.6	9.9	1
C1-Naphthalenes	0.39	0.21	0.17	0.19 U	0.12 U	0.12 U	1.5 U	0.18 U
C1-Phenan/Anthracenes	3.1	1.7	3	1.3	0.7	0.85	4.6	0.52
C2-Chrysene	9.8	1.8	8.3	1.6	0.82	0.45	2.7	0.29
C2-Florenes	1.3	1.4	1.7	0.6	0.29	0.15	1.5 U	0.18 U
C2-Naphthalenes	1.7	1.7	1.7	0.53	0.34	0.36	1.5 U	0.18 U
C2-Phenan/Anthracenes	5.8	2.7	7.2	2.5	0.74	0.48	1.6	0.2
C3-Chrysene	5.5	1.2	5.2	0.88	0.4	0.18	1.5 U	0.18 U
C3-Florenes	3.9	2.8	5.1	1.6	0.75	0.38	1.5 U	0.18 U
C3-Naphthalenes	2.4	3.4	4.3	1.5	0.59	0.29	1.5 U	0.18 U
C3-Phenan/Anthracenes	8.5	2.9	9.3	3.3	1.1	0.54	1.5 U	0.18 U
C4-Chrysene	2.1	0.43	2.8	0.46	0.18	0.12 U	1.5 U	0.18 U
C4-Naphthalenes	3	4.1	5	1.7	0.72	0.39	1.5 U	0.18 U
C4-Phenan/Anthracenes	5.6	1.6	5.5	1.9	0.62	0.3	1.5 U	0.18 U
Chrysene	5.1	2.1	2.9	3.3	2.4	2.3	19	2.1
Dibenz(a,h)anthracene	0.72	0.27	0.43	0.58	0.26	0.34	2.9	0.32
Flouranthene	4.2	3.5	3	6.4	4.8	6	48	5.3
Fluorene	0.15	0.2	0.2	0.19 U	0.12	0.37	1.7	0.18 U
Indeno(1,2,3-cd)pyrene	2.3	1.6	1.3	2.3	1.6	1.4	15	1.4
Naphthalene	0.19	0.12 U	0.12 U	0.19 U	0.12 U	0.12 U	1.5 U	0.18 U
Perylene	0.92	0.42	0.64	0.6	0.47	0.49	4.5	0.42
Phenanthrene	1.2	0.84	0.98	1.7	1.4	3.2	19	1.9
Pyrene	4.9	3.3	4	5.3	3.7	4.4	36	3.7

Notes:

IS = Estimated value. Internal standard recoveries exceed the upper or lower control limits.

J = Estimated value. Greater than detection limit, but less than reporting limit.

U = Analyte not detected at or above reporting limit.

All values expressed in milligrams per kilogram

TABLE B-7
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - AVS/SEM
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Parameter	Sample Number and Date Collected					
	DC-SED-01 4/05/07	DC-SED-03 4/05/07	DC-SED-05 4/05/07	DC-SED-08 4/05/07	DC-SED-10 4/05/07	DC-SED-13 4/05/07
Cadmium	0.0058 B	0.0085 B	0.011	0.0088	0.0049	0.0077
Copper	0.094 B	0.05 B	0.035	0.087	0.074	0.099
Lead	0.08	0.097	0.21	0.14	0.082	0.83
Nickel	0.1 B	0.065 B	0.24 B	0.18 B	0.09 B	0.14 B
Silver	0.012 M, MS	0.011 M, MS	0.023 M, MS	0.039 M, MS	0.019 M, MS	0.014 M, MS
Zinc	1 SD	0.79 SD	2.9 SD	1.7 SD	0.77 SD	0.83 SD
Mercury	0.00018 M	0.00016 M	0.00035 M	0.0006 M	0.00028 M	0.00021 M
Total SEM	1.29198	1.02166	3.41935	2.1554	1.04018	1.92091
Acid Volatile Sulfide	8.7 M	10.3 M	59.3 M	76.4 M	11.3 M	20.3 M
Ratio of SEM*/AVS	0.15	0.097	0.057	0.027	0.088	0.094
Acid Volatile Sulfide (mg/kg)	279	329	1900	2450	361	652

TABLE B-7
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - AVS/SEM
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Parameter	Sample Number and Date Collected					
	DC-SED-14 4/05/07	OC-SED-01 4/05/07	OC-SED-03 4/05/07	OC-SED-05 4/05/07	OC-SED-07 4/05/07	OC-SED-11 4/05/07
Cadmium	0.0038	0.0028 B	0.0071 B	0.0072	0.006	0.0073
Copper	0.025 U	0.23	0.67	0.62	0.33	0.052
Lead	0.14	0.09	0.31	0.31	0.32	0.33
Nickel	0.055 B	0.087 B	0.22 B	0.22 B	0.21 B	0.25 B
Silver	0.019 M, MS	0.013 M, MS	0.02 M, MS	0.019 M, MS	0.019 M, MS	0.019 M, MS
Zinc	0.99 SD	0.76 SD	2.6 SD	2.7 SD	1 SD	2.9 SD
Mercury	0.00029 M	0.00019 M	0.00031 M	0.00029 M	0.00029 M	0.00029 M
Total SEM	1.23309	1.18299	3.82741	3.87649	1.88529	3.55859
Acid Volatile Sulfide	21.9 M	2.5 M	17.6 M	14 M	23.4 M	32.1 M
Ratio of SEM*/AVS	0.055	0.48	0.22	0.28	0.12	0.11
Acid Volatile Sulfide (mg/kg)	702	80.1	565	450	749	1030

TABLE B-7
SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - AVS/SEM
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Parameter	Sample Number and Date Collected			
	OC-SED-14 4/05/07	OC-SED-19 4/05/07	OC-SED-22 4/05/07	OC-SED-26 4/05/07
Cadmium	0.006	0.0028	0.0062	0.0043
Copper	0.27	0.18	0.016 U	0.17
Lead	0.36	0.13	0.22	0.17
Nickel	0.24 B	0.11 B	0.12 B	0.22 B
Silver	0.014 M, MS	0.0093 M, MS	0.012 M, MS	0.015 F, MS
Zinc	2.1 SD	1.3 SD	2.6 SD	1.1 F, CV
Mercury	0.0002 M	0.00014 M	0.00018 M	0.00022 F, MS
Total SEM	2.9902	1.73224	2.97438	1.67952
Acid Volatile Sulfide	16.9 M	8.7 M	39 M	7.2 M
Ratio of SEM*/AVS	0.18	0.2	0.074	0.24
Acid Volatile Sulfide (mg/kg)	543	280	1250	231

Notes:

AVS = Acid volatile sulfide

B = Result is less than reporting limit but greater than instrument detection limit.

CV = Estimated value. Calibration verification results exceed upper or lower control limits.

F = Estimated value. Relative Percent Difference of field duplicates/replicates exceeds criteria.

mg/kg = Milligrams per kilogram

M = Estimated value. Associated MS/MSD recoveries exceed the upper or lower control limits.

MS = Estimated value. RPD between MS/MSD exceeded specified criteria.

SD = Estimated value. Serial dilution exceeds specified criteria.

SEM = Simultaneously extracted metals

All results expressed in micromoles per gram unless otherwise noted

TABLE B-8
SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Sample Name	Analyte	Result	Units	Basis	Percent Solids
S01-DC-01	Sieve 3/8	25.9	% retained on sieve	Wet	76.9
S01-DC-01	Sieve 4	11.1	% retained on sieve	Wet	76.9
S01-DC-01	Sieve 10	9.3	% retained on sieve	Wet	76.9
S01-DC-01	Sieve 16	5.7	% retained on sieve	Wet	76.9
S01-DC-01	Sieve 35	11.0	% retained on sieve	Wet	76.9
S01-DC-01	Sieve 50	7.3	% retained on sieve	Wet	76.9
S01-DC-01	Sieve 100	9.0	% retained on sieve	Wet	76.9
S01-DC-01	Sieve 200	1.1	% retained on sieve	Wet	76.9
S01-DC-01	Sieve bottom plate	3.3	% retained on sieve	Wet	76.9
S02-DC-02	Sieve 3/8	2.3	% retained on sieve	Wet	34.2
S02-DC-02	Sieve 4	0.7	% retained on sieve	Wet	34.2
S02-DC-02	Sieve 10	1.2	% retained on sieve	Wet	34.2
S02-DC-02	Sieve 16	0.8	% retained on sieve	Wet	34.2
S02-DC-02	Sieve 35	1.3	% retained on sieve	Wet	34.2
S02-DC-02	Sieve 50	1.7	% retained on sieve	Wet	34.2
S02-DC-02	Sieve 100	3.4	% retained on sieve	Wet	34.2
S02-DC-02	Sieve 200	4.7	% retained on sieve	Wet	34.2
S02-DC-02	Sieve bottom plate	1.3	% retained on sieve	Wet	34.2
S03-DC-03	Sieve 3/8	0.04	% retained on sieve	Wet	69.4
S03-DC-03	Sieve 4	1.5	% retained on sieve	Wet	69.4
S03-DC-03	Sieve 10	8.6	% retained on sieve	Wet	69.4
S03-DC-03	Sieve 16	5.7	% retained on sieve	Wet	69.4
S03-DC-03	Sieve 35	14.6	% retained on sieve	Wet	69.4
S03-DC-03	Sieve 50	12.7	% retained on sieve	Wet	69.4
S03-DC-03	Sieve 100	34.7	% retained on sieve	Wet	69.4
S03-DC-03	Sieve 200	9.8	% retained on sieve	Wet	69.4
S03-DC-03	Sieve bottom plate	4.2	% retained on sieve	Wet	69.4
S04-DC-04	Sieve 3/8	0.2	% retained on sieve	Wet	32.3
S04-DC-04	Sieve 4	0.6	% retained on sieve	Wet	32.3
S04-DC-04	Sieve 10	1.1	% retained on sieve	Wet	32.3
S04-DC-04	Sieve 16	1.1	% retained on sieve	Wet	32.3
S04-DC-04	Sieve 35	1.9	% retained on sieve	Wet	32.3
S04-DC-04	Sieve 50	1.4	% retained on sieve	Wet	32.3
S04-DC-04	Sieve 100	3.4	% retained on sieve	Wet	32.3
S04-DC-04	Sieve 200	1.4	% retained on sieve	Wet	32.3
S04-DC-04	Sieve bottom plate	3.8	% retained on sieve	Wet	32.3
S05-DC-05	Sieve 3/8	0.03	% retained on sieve	Wet	34.1
S05-DC-05	Sieve 4	0.2	% retained on sieve	Wet	34.1
S05-DC-05	Sieve 10	0.9	% retained on sieve	Wet	34.1
S05-DC-05	Sieve 16	0.8	% retained on sieve	Wet	34.1
S05-DC-05	Sieve 35	1.0	% retained on sieve	Wet	34.1
S05-DC-05	Sieve 50	1.2	% retained on sieve	Wet	34.1
S05-DC-05	Sieve 100	1.5	% retained on sieve	Wet	34.1
S05-DC-05	Sieve 200	1.8	% retained on sieve	Wet	34.1
S05-DC-05	Sieve bottom plate	0.5	% retained on sieve	Wet	34.1

TABLE B-8
SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Sample Name	Analyte	Result	Units	Basis	Percent Solids
S06-DC-06	Sieve 3/8	2.1	% retained on sieve	Wet	37.9
S06-DC-06	Sieve 4	2.4	% retained on sieve	Wet	37.9
S06-DC-06	Sieve 10	3.3	% retained on sieve	Wet	37.9
S06-DC-06	Sieve 16	2.5	% retained on sieve	Wet	37.9
S06-DC-06	Sieve 35	6.5	% retained on sieve	Wet	37.9
S06-DC-06	Sieve 50	4.6	% retained on sieve	Wet	37.9
S06-DC-06	Sieve 100	9.9	% retained on sieve	Wet	37.9
S06-DC-06	Sieve 200	13.4	% retained on sieve	Wet	37.9
S06-DC-06	Sieve bottom plate	7.4	% retained on sieve	Wet	37.9
S07-DC-07	Sieve 3/8	2.6	% retained on sieve	Wet	29.1
S07-DC-07	Sieve 4	1.4	% retained on sieve	Wet	29.1
S07-DC-07	Sieve 10	2.1	% retained on sieve	Wet	29.1
S07-DC-07	Sieve 16	1.7	% retained on sieve	Wet	29.1
S07-DC-07	Sieve 35	2.5	% retained on sieve	Wet	29.1
S07-DC-07	Sieve 50	2.8	% retained on sieve	Wet	29.1
S07-DC-07	Sieve 100	3.9	% retained on sieve	Wet	29.1
S07-DC-07	Sieve 200	3.5	% retained on sieve	Wet	29.1
S07-DC-07	Sieve bottom plate	1.1	% retained on sieve	Wet	29.1
S08-DC-08	Sieve 3/8	0.03	% retained on sieve	Wet	21.5
S08-DC-08	Sieve 4	0.3	% retained on sieve	Wet	21.5
S08-DC-08	Sieve 10	1.1	% retained on sieve	Wet	21.5
S08-DC-08	Sieve 16	0.9	% retained on sieve	Wet	21.5
S08-DC-08	Sieve 35	-0.8	% retained on sieve	Wet	21.5
S08-DC-08	Sieve 50	1.1	% retained on sieve	Wet	21.5
S08-DC-08	Sieve 100	1.6	% retained on sieve	Wet	21.5
S08-DC-08	Sieve 200	1.3	% retained on sieve	Wet	21.5
S08-DC-08	Sieve bottom plate	1.5	% retained on sieve	Wet	21.5
S09-DC-09	Sieve 3/8	0.0	% retained on sieve	Wet	33.9
S09-DC-09	Sieve 4	2.0	% retained on sieve	Wet	33.9
S09-DC-09	Sieve 10	3.7	% retained on sieve	Wet	33.9
S09-DC-09	Sieve 16	3.1	% retained on sieve	Wet	33.9
S09-DC-09	Sieve 35	5.6	% retained on sieve	Wet	33.9
S09-DC-09	Sieve 50	6.2	% retained on sieve	Wet	33.9
S09-DC-09	Sieve 100	9.2	% retained on sieve	Wet	33.9
S09-DC-09	Sieve 200	10.9	% retained on sieve	Wet	33.9
S09-DC-09	Sieve bottom plate	2.6	% retained on sieve	Wet	33.9
S10-DC-10	Sieve 3/8	0.0	% retained on sieve	Wet	44.0
S10-DC-10	Sieve 4	0.2	% retained on sieve	Wet	44.0
S10-DC-10	Sieve 10	0.7	% retained on sieve	Wet	44.0
S10-DC-10	Sieve 16	0.6	% retained on sieve	Wet	44.0
S10-DC-10	Sieve 35	1.6	% retained on sieve	Wet	44.0
S10-DC-10	Sieve 50	1.1	% retained on sieve	Wet	44.0
S10-DC-10	Sieve 100	2.4	% retained on sieve	Wet	44.0
S10-DC-10	Sieve 200	1.4	% retained on sieve	Wet	44.0
S10-DC-10	Sieve bottom plate	4.1	% retained on sieve	Wet	44.0

TABLE B-8
SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Sample Name	Analyte	Result	Units	Basis	Percent Solids
S11-DC-11	Sieve 3/8	0.0	% retained on sieve	Wet	29.2
S11-DC-11	Sieve 4	0.0	% retained on sieve	Wet	29.2
S11-DC-11	Sieve 10	0.2	% retained on sieve	Wet	29.2
S11-DC-11	Sieve 16	0.3	% retained on sieve	Wet	29.2
S11-DC-11	Sieve 35	0.3	% retained on sieve	Wet	29.2
S11-DC-11	Sieve 50	0.3	% retained on sieve	Wet	29.2
S11-DC-11	Sieve 100	0.6	% retained on sieve	Wet	29.2
S11-DC-11	Sieve 200	1.4	% retained on sieve	Wet	29.2
S11-DC-11	Sieve bottom plate	1.0	% retained on sieve	Wet	29.2
S12-DC-12	Sieve 3/8	0.1	% retained on sieve	Wet	15.8
S12-DC-12	Sieve 4	2.1	% retained on sieve	Wet	15.8
S12-DC-12	Sieve 10	4.4	% retained on sieve	Wet	15.8
S12-DC-12	Sieve 16	3.2	% retained on sieve	Wet	15.8
S12-DC-12	Sieve 35	6.1	% retained on sieve	Wet	15.8
S12-DC-12	Sieve 50	3.1	% retained on sieve	Wet	15.8
S12-DC-12	Sieve 100	4.0	% retained on sieve	Wet	15.8
S12-DC-12	Sieve 200	0.3	% retained on sieve	Wet	15.8
S12-DC-12	Sieve bottom plate	5.0	% retained on sieve	Wet	15.8
S13-DC-13	Sieve 3/8	9.0	% retained on sieve	Wet	56.7
S13-DC-13	Sieve 4	6.3	% retained on sieve	Wet	56.7
S13-DC-13	Sieve 10	4.8	% retained on sieve	Wet	56.7
S13-DC-13	Sieve 16	3.1	% retained on sieve	Wet	56.7
S13-DC-13	Sieve 35	4.6	% retained on sieve	Wet	56.7
S13-DC-13	Sieve 50	6.5	% retained on sieve	Wet	56.7
S13-DC-13	Sieve 100	11.1	% retained on sieve	Wet	56.7
S13-DC-13	Sieve 200	14.0	% retained on sieve	Wet	56.7
S13-DC-13	Sieve bottom plate	3.2	% retained on sieve	Wet	56.7

TABLE B-8
SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Sample Name	Analyte	Result	Units	Basis	Percent Solids
S14-DC-14	Sieve 3/8	4.0	% retained on sieve	Wet	34.9
S14-DC-14	Sieve 4	12.5	% retained on sieve	Wet	34.9
S14-DC-14	Sieve 10	15.5	% retained on sieve	Wet	34.9
S14-DC-14	Sieve 16	7.2	% retained on sieve	Wet	34.9
S14-DC-14	Sieve 35	13.7	% retained on sieve	Wet	34.9
S14-DC-14	Sieve 50	10.4	% retained on sieve	Wet	34.9
S14-DC-14	Sieve 100	17.8	% retained on sieve	Wet	34.9
S14-DC-14	Sieve 200	3.4	% retained on sieve	Wet	34.9
S14-DC-14	Sieve bottom plate	9.1	% retained on sieve	Wet	34.9
S15-DC-15	Sieve 3/8	4.9	% retained on sieve	Wet	61.4
S15-DC-15	Sieve 4	9.5	% retained on sieve	Wet	61.4
S15-DC-15	Sieve 10	9.1	% retained on sieve	Wet	61.4
S15-DC-15	Sieve 16	5.0	% retained on sieve	Wet	61.4
S15-DC-15	Sieve 35	8.0	% retained on sieve	Wet	61.4
S15-DC-15	Sieve 50	11.0	% retained on sieve	Wet	61.4
S15-DC-15	Sieve 100	14.7	% retained on sieve	Wet	61.4
S15-DC-15	Sieve 200	13.3	% retained on sieve	Wet	61.4
S15-DC-15	Sieve bottom plate	3.3	% retained on sieve	Wet	61.4
S16-DC-16	Sieve 3/8	0.1	% retained on sieve	Wet	31.1
S16-DC-16	Sieve 4	-0.01	% retained on sieve	Wet	31.1
S16-DC-16	Sieve 10	0.0	% retained on sieve	Wet	31.1
S16-DC-16	Sieve 16	0.0	% retained on sieve	Wet	31.1
S16-DC-16	Sieve 35	0.06	% retained on sieve	Wet	31.1
S16-DC-16	Sieve 50	0.2	% retained on sieve	Wet	31.1
S16-DC-16	Sieve 100	0.3	% retained on sieve	Wet	31.1
S16-DC-16	Sieve 200	-0.01	% retained on sieve	Wet	31.1
S16-DC-16	Sieve bottom plate	0.4	% retained on sieve	Wet	31.1
S17-DC-17	Sieve 3/8	0.0	% retained on sieve	Wet	30.5
S17-DC-17	Sieve 4	0.0	% retained on sieve	Wet	30.5
S17-DC-17	Sieve 10	0.0	% retained on sieve	Wet	30.5
S17-DC-17	Sieve 16	0.0	% retained on sieve	Wet	30.5
S17-DC-17	Sieve 35	0.04	% retained on sieve	Wet	30.5
S17-DC-17	Sieve 50	0.03	% retained on sieve	Wet	30.5
S17-DC-17	Sieve 100	0.07	% retained on sieve	Wet	30.5
S17-DC-17	Sieve 200	0.1	% retained on sieve	Wet	30.5
S17-DC-17	Sieve bottom plate	0.3	% retained on sieve	Wet	30.5
S18-DC-18	Sieve 3/8	0.0	% retained on sieve	Wet	33.0
S18-DC-18	Sieve 4	0.0	% retained on sieve	Wet	33.0
S18-DC-18	Sieve 10	0.0	% retained on sieve	Wet	33.0
S18-DC-18	Sieve 16	0.0	% retained on sieve	Wet	33.0
S18-DC-18	Sieve 35	0.03	% retained on sieve	Wet	33.0
S18-DC-18	Sieve 50	0.0	% retained on sieve	Wet	33.0
S18-DC-18	Sieve 100	0.5	% retained on sieve	Wet	33.0
S18-DC-18	Sieve 200	0.3	% retained on sieve	Wet	33.0
S18-DC-18	Sieve bottom plate	0.3	% retained on sieve	Wet	33.0

TABLE B-8
SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Sample Name	Analyte	Result	Units	Basis	Percent Solids
S19-DC-19	Sieve 3/8	0.4	% retained on sieve	Wet	62.8
S19-DC-19	Sieve 4	3.3	% retained on sieve	Wet	62.8
S19-DC-19	Sieve 10	6.9	% retained on sieve	Wet	62.8
S19-DC-19	Sieve 16	4.0	% retained on sieve	Wet	62.8
S19-DC-19	Sieve 35	9.4	% retained on sieve	Wet	62.8
S19-DC-19	Sieve 50	9.1	% retained on sieve	Wet	62.8
S19-DC-19	Sieve 100	17.9	% retained on sieve	Wet	62.8
S19-DC-19	Sieve 200	0.3	% retained on sieve	Wet	62.8
S19-DC-19	Sieve bottom plate	18.0	% retained on sieve	Wet	62.8
S20-OC-01	Sieve 3/8	3.4	% retained on sieve	Wet	65.8
S20-OC-01	Sieve 4	2.3	% retained on sieve	Wet	65.8
S20-OC-01	Sieve 10	1.0	% retained on sieve	Wet	65.8
S20-OC-01	Sieve 16	0.5	% retained on sieve	Wet	65.8
S20-OC-01	Sieve 35	0.01	% retained on sieve	Wet	65.8
S20-OC-01	Sieve 50	2.6	% retained on sieve	Wet	65.8
S20-OC-01	Sieve 100	17.1	% retained on sieve	Wet	65.8
S20-OC-01	Sieve 200	32.6	% retained on sieve	Wet	65.8
S20-OC-01	Sieve bottom plate	6.9	% retained on sieve	Wet	65.8
S21-OC-02	Sieve 3/8	0.0	% retained on sieve	Wet	46.2
S21-OC-02	Sieve 4	0.07	% retained on sieve	Wet	46.2
S21-OC-02	Sieve 10	0.9	% retained on sieve	Wet	46.2
S21-OC-02	Sieve 16	0.5	% retained on sieve	Wet	46.2
S21-OC-02	Sieve 35	0.6	% retained on sieve	Wet	46.2
S21-OC-02	Sieve 50	0.9	% retained on sieve	Wet	46.2
S21-OC-02	Sieve 100	0.6	% retained on sieve	Wet	46.2
S21-OC-02	Sieve 200	0.07	% retained on sieve	Wet	46.2
S21-OC-02	Sieve bottom plate	1.4	% retained on sieve	Wet	46.2
S22-OC-03	Sieve 3/8	-0.5	% retained on sieve	Wet	37.1
S22-OC-03	Sieve 4	0.9	% retained on sieve	Wet	37.1
S22-OC-03	Sieve 10	0.9	% retained on sieve	Wet	37.1
S22-OC-03	Sieve 16	1.1	% retained on sieve	Wet	37.1
S22-OC-03	Sieve 35	3.1	% retained on sieve	Wet	37.1
S22-OC-03	Sieve 50	2.6	% retained on sieve	Wet	37.1
S22-OC-03	Sieve 100	1.7	% retained on sieve	Wet	37.1
S22-OC-03	Sieve 200	8.4	% retained on sieve	Wet	37.1
S22-OC-03	Sieve bottom plate	9.5	% retained on sieve	Wet	37.1
S23-OC-04	Sieve 3/8	0.0	% retained on sieve	Wet	44.2
S23-OC-04	Sieve 4	0.0	% retained on sieve	Wet	44.2
S23-OC-04	Sieve 10	0.07	% retained on sieve	Wet	44.2
S23-OC-04	Sieve 16	0.05	% retained on sieve	Wet	44.2
S23-OC-04	Sieve 35	0.08	% retained on sieve	Wet	44.2
S23-OC-04	Sieve 50	0.1	% retained on sieve	Wet	44.2
S23-OC-04	Sieve 100	0.3	% retained on sieve	Wet	44.2
S23-OC-04	Sieve 200	0.5	% retained on sieve	Wet	44.2
S23-OC-04	Sieve bottom plate	0.2	% retained on sieve	Wet	44.2

TABLE B-8
SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Sample Name	Analyte	Result	Units	Basis	Percent Solids
S24-OC-05	Sieve 3/8	0.01	% retained on sieve	Wet	42.0
S24-OC-05	Sieve 4	0.01	% retained on sieve	Wet	42.0
S24-OC-05	Sieve 10	0.1	% retained on sieve	Wet	42.0
S24-OC-05	Sieve 16	0.2	% retained on sieve	Wet	42.0
S24-OC-05	Sieve 35	0.8	% retained on sieve	Wet	42.0
S24-OC-05	Sieve 50	0.5	% retained on sieve	Wet	42.0
S24-OC-05	Sieve 100	0.08	% retained on sieve	Wet	42.0
S24-OC-05	Sieve 200	4.5	% retained on sieve	Wet	42.0
S24-OC-05	Sieve bottom plate	1.1	% retained on sieve	Wet	42.0
S25-OC-06	Sieve 3/8	-0.4	% retained on sieve	Wet	49.0
S25-OC-06	Sieve 4	0.0	% retained on sieve	Wet	49.0
S25-OC-06	Sieve 10	-0.1	% retained on sieve	Wet	49.0
S25-OC-06	Sieve 16	0.2	% retained on sieve	Wet	49.0
S25-OC-06	Sieve 35	0.3	% retained on sieve	Wet	49.0
S25-OC-06	Sieve 50	0.1	% retained on sieve	Wet	49.0
S25-OC-06	Sieve 100	0.3	% retained on sieve	Wet	49.0
S25-OC-06	Sieve 200	2.2	% retained on sieve	Wet	49.0
S25-OC-06	Sieve bottom plate	1.4	% retained on sieve	Wet	49.0
S26-OC-07	Sieve 3/8	2.0	% retained on sieve	Wet	49.9
S26-OC-07	Sieve 4	6.3	% retained on sieve	Wet	49.9
S26-OC-07	Sieve 10	6.0	% retained on sieve	Wet	49.9
S26-OC-07	Sieve 16	4.1	% retained on sieve	Wet	49.9
S26-OC-07	Sieve 35	7.7	% retained on sieve	Wet	49.9
S26-OC-07	Sieve 50	14.9	% retained on sieve	Wet	49.9
S26-OC-07	Sieve 100	14.0	% retained on sieve	Wet	49.9
S26-OC-07	Sieve 200	6.5	% retained on sieve	Wet	49.9
S26-OC-07	Sieve bottom plate	3.4	% retained on sieve	Wet	49.9
S27-OC-08	Sieve 3/8	-0.03	% retained on sieve	Wet	58.7
S27-OC-08	Sieve 4	0.7	% retained on sieve	Wet	58.7
S27-OC-08	Sieve 10	2.2	% retained on sieve	Wet	58.7
S27-OC-08	Sieve 16	3.1	% retained on sieve	Wet	58.7
S27-OC-08	Sieve 35	13.9	% retained on sieve	Wet	58.7
S27-OC-08	Sieve 50	11.3	% retained on sieve	Wet	58.7
S27-OC-08	Sieve 100	5.2	% retained on sieve	Wet	58.7
S27-OC-08	Sieve 200	25.5	% retained on sieve	Wet	58.7
S27-OC-08	Sieve bottom plate	6.6	% retained on sieve	Wet	58.7
S28-OC-09	Sieve 3/8	0.0	% retained on sieve	Wet	66.8
S28-OC-09	Sieve 4	1.8	% retained on sieve	Wet	66.8
S28-OC-09	Sieve 10	5.3	% retained on sieve	Wet	66.8
S28-OC-09	Sieve 16	5.5	% retained on sieve	Wet	66.8
S28-OC-09	Sieve 35	9.5	% retained on sieve	Wet	66.8
S28-OC-09	Sieve 50	15.1	% retained on sieve	Wet	66.8
S28-OC-09	Sieve 100	15.3	% retained on sieve	Wet	66.8
S28-OC-09	Sieve 200	11.8	% retained on sieve	Wet	66.8
S28-OC-09	Sieve bottom plate	3.5	% retained on sieve	Wet	66.8

TABLE B-8
SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Sample Name	Analyte	Result	Units	Basis	Percent Solids
S29-OC-10	Sieve 3/8	0.6	% retained on sieve	Wet	58.3
S29-OC-10	Sieve 4	5.0	% retained on sieve	Wet	58.3
S29-OC-10	Sieve 10	8.7	% retained on sieve	Wet	58.3
S29-OC-10	Sieve 16	7.5	% retained on sieve	Wet	58.3
S29-OC-10	Sieve 35	13.3	% retained on sieve	Wet	58.3
S29-OC-10	Sieve 50	15.0	% retained on sieve	Wet	58.3
S29-OC-10	Sieve 100	12.7	% retained on sieve	Wet	58.3
S29-OC-10	Sieve 200	9.5	% retained on sieve	Wet	58.3
S29-OC-10	Sieve bottom plate	3.0	% retained on sieve	Wet	58.3
S30-OC-11	Sieve 3/8	0.0	% retained on sieve	Wet	45.7
S30-OC-11	Sieve 4	0.5	% retained on sieve	Wet	45.7
S30-OC-11	Sieve 10	3.4	% retained on sieve	Wet	45.7
S30-OC-11	Sieve 16	3.8	% retained on sieve	Wet	45.7
S30-OC-11	Sieve 35	5.2	% retained on sieve	Wet	45.7
S30-OC-11	Sieve 50	6.1	% retained on sieve	Wet	45.7
S30-OC-11	Sieve 100	15.0	% retained on sieve	Wet	45.7
S30-OC-11	Sieve 200	18.6	% retained on sieve	Wet	45.7
S30-OC-11	Sieve bottom plate	6.1	% retained on sieve	Wet	45.7
S31-OC-12	Sieve 3/8	0.0	% retained on sieve	Wet	57.3
S31-OC-12	Sieve 4	3.0	% retained on sieve	Wet	57.3
S31-OC-12	Sieve 10	4.1	% retained on sieve	Wet	57.3
S31-OC-12	Sieve 16	5.7	% retained on sieve	Wet	57.3
S31-OC-12	Sieve 35	21.6	% retained on sieve	Wet	57.3
S31-OC-12	Sieve 50	12.9	% retained on sieve	Wet	57.3
S31-OC-12	Sieve 100	1.8	% retained on sieve	Wet	57.3
S31-OC-12	Sieve 200	20.4	% retained on sieve	Wet	57.3
S31-OC-12	Sieve bottom plate	3.4	% retained on sieve	Wet	57.3
S32-OC-13	Sieve 3/8	0.03	% retained on sieve	Wet	71.3
S32-OC-13	Sieve 4	0.9	% retained on sieve	Wet	71.3
S32-OC-13	Sieve 10	4.8	% retained on sieve	Wet	71.3
S32-OC-13	Sieve 16	5.7	% retained on sieve	Wet	71.3
S32-OC-13	Sieve 35	17.6	% retained on sieve	Wet	71.3
S32-OC-13	Sieve 50	12.5	% retained on sieve	Wet	71.3
S32-OC-13	Sieve 100	8.9	% retained on sieve	Wet	71.3
S32-OC-13	Sieve 200	19.3	% retained on sieve	Wet	71.3
S32-OC-13	Sieve bottom plate	10.8	% retained on sieve	Wet	71.3
S33-OC-14	Sieve 3/8	0.03	% retained on sieve	Wet	65.5
S33-OC-14	Sieve 4	3.2	% retained on sieve	Wet	65.5
S33-OC-14	Sieve 10	6.6	% retained on sieve	Wet	65.5
S33-OC-14	Sieve 16	5.0	% retained on sieve	Wet	65.5
S33-OC-14	Sieve 35	9.2	% retained on sieve	Wet	65.5
S33-OC-14	Sieve 50	13.7	% retained on sieve	Wet	65.5
S33-OC-14	Sieve 100	15.8	% retained on sieve	Wet	65.5
S33-OC-14	Sieve 200	9.5	% retained on sieve	Wet	65.5
S33-OC-14	Sieve bottom plate	2.1	% retained on sieve	Wet	65.5

TABLE B-8
SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Sample Name	Analyte	Result	Units	Basis	Percent Solids
S34-OC-15	Sieve 3/8	0.3	% retained on sieve	Wet	59.9
S34-OC-15	Sieve 4	3.7	% retained on sieve	Wet	59.9
S34-OC-15	Sieve 10	15.1	% retained on sieve	Wet	59.9
S34-OC-15	Sieve 16	11.5	% retained on sieve	Wet	59.9
S34-OC-15	Sieve 35	21.7	% retained on sieve	Wet	59.9
S34-OC-15	Sieve 50	9.0	% retained on sieve	Wet	59.9
S34-OC-15	Sieve 100	0.7	% retained on sieve	Wet	59.9
S34-OC-15	Sieve 200	13.6	% retained on sieve	Wet	59.9
S34-OC-15	Sieve bottom plate	2.7	% retained on sieve	Wet	59.9
S35-OC-16	Sieve 3/8	0.0	% retained on sieve	Wet	62.7
S35-OC-16	Sieve 4	8.5	% retained on sieve	Wet	62.7
S35-OC-16	Sieve 10	11.3	% retained on sieve	Wet	62.7
S35-OC-16	Sieve 16	7.3	% retained on sieve	Wet	62.7
S35-OC-16	Sieve 35	13.8	% retained on sieve	Wet	62.7
S35-OC-16	Sieve 50	10.1	% retained on sieve	Wet	62.7
S35-OC-16	Sieve 100	1.2	% retained on sieve	Wet	62.7
S35-OC-16	Sieve 200	17.9	% retained on sieve	Wet	62.7
S35-OC-16	Sieve bottom plate	2.4	% retained on sieve	Wet	62.7
S36-OC-17	Sieve 3/8	1.2	% retained on sieve	Wet	63.2
S36-OC-17	Sieve 4	1.6	% retained on sieve	Wet	63.2
S36-OC-17	Sieve 10	6.8	% retained on sieve	Wet	63.2
S36-OC-17	Sieve 16	8.2	% retained on sieve	Wet	63.2
S36-OC-17	Sieve 35	19.2	% retained on sieve	Wet	63.2
S36-OC-17	Sieve 50	25.0	% retained on sieve	Wet	63.2
S36-OC-17	Sieve 100	17.4	% retained on sieve	Wet	63.2
S36-OC-17	Sieve 200	7.1	% retained on sieve	Wet	63.2
S36-OC-17	Sieve bottom plate	1.6	% retained on sieve	Wet	63.2
S37-OC-18	Sieve 3/8	3.5	% retained on sieve	Wet	64.2
S37-OC-18	Sieve 4	0.9	% retained on sieve	Wet	64.2
S37-OC-18	Sieve 10	3.0	% retained on sieve	Wet	64.2
S37-OC-18	Sieve 16	1.9	% retained on sieve	Wet	64.2
S37-OC-18	Sieve 35	10.6	% retained on sieve	Wet	64.2
S37-OC-18	Sieve 50	24.4	% retained on sieve	Wet	64.2
S37-OC-18	Sieve 100	4.2	% retained on sieve	Wet	64.2
S37-OC-18	Sieve 200	33.8	% retained on sieve	Wet	64.2
S37-OC-18	Sieve bottom plate	3.7	% retained on sieve	Wet	64.2
S38-OC-19	Sieve 3/8	3.0	% retained on sieve	Wet	77.5
S38-OC-19	Sieve 4	1.9	% retained on sieve	Wet	77.5
S38-OC-19	Sieve 10	11.7	% retained on sieve	Wet	77.5
S38-OC-19	Sieve 16	13.5	% retained on sieve	Wet	77.5
S38-OC-19	Sieve 35	23.4	% retained on sieve	Wet	77.5
S38-OC-19	Sieve 50	12.6	% retained on sieve	Wet	77.5
S38-OC-19	Sieve 100	16.2	% retained on sieve	Wet	77.5
S38-OC-19	Sieve 200	1.9	% retained on sieve	Wet	77.5
S38-OC-19	Sieve bottom plate	6.2	% retained on sieve	Wet	77.5

TABLE B-8
SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Sample Name	Analyte	Result	Units	Basis	Percent Solids
S39-OC-20	Sieve 3/8	2.4	% retained on sieve	Wet	67.7
S39-OC-20	Sieve 4	2.1	% retained on sieve	Wet	67.7
S39-OC-20	Sieve 10	9.2	% retained on sieve	Wet	67.7
S39-OC-20	Sieve 16	10.5	% retained on sieve	Wet	67.7
S39-OC-20	Sieve 35	22.8	% retained on sieve	Wet	67.7
S39-OC-20	Sieve 50	13.0	% retained on sieve	Wet	67.7
S39-OC-20	Sieve 100	7.1	% retained on sieve	Wet	67.7
S39-OC-20	Sieve 200	8.9	% retained on sieve	Wet	67.7
S39-OC-20	Sieve bottom plate	7.8	% retained on sieve	Wet	67.7
S40-OC-21	Sieve 3/8	0.3	% retained on sieve	Wet	47.2
S40-OC-21	Sieve 4	2.5	% retained on sieve	Wet	47.2
S40-OC-21	Sieve 10	4.4	% retained on sieve	Wet	47.2
S40-OC-21	Sieve 16	5.9	% retained on sieve	Wet	47.2
S40-OC-21	Sieve 35	12.9	% retained on sieve	Wet	47.2
S40-OC-21	Sieve 50	16.7	% retained on sieve	Wet	47.2
S40-OC-21	Sieve 100	17.5	% retained on sieve	Wet	47.2
S40-OC-21	Sieve 200	15.3	% retained on sieve	Wet	47.2
S40-OC-21	Sieve bottom plate	5.5	% retained on sieve	Wet	47.2
S41-OC-21A	Sieve 3/8	0.0	% retained on sieve	Wet	54.8
S41-OC-21A	Sieve 4	0.5	% retained on sieve	Wet	54.8
S41-OC-21A	Sieve 10	1.5	% retained on sieve	Wet	54.8
S41-OC-21A	Sieve 16	1.7	% retained on sieve	Wet	54.8
S41-OC-21A	Sieve 35	5.1	% retained on sieve	Wet	54.8
S41-OC-21A	Sieve 50	4.5	% retained on sieve	Wet	54.8
S41-OC-21A	Sieve 100	4.8	% retained on sieve	Wet	54.8
S41-OC-21A	Sieve 200	19.8	% retained on sieve	Wet	54.8
S41-OC-21A	Sieve bottom plate	18.2	% retained on sieve	Wet	54.8
S42-OC-22	Sieve 3/8	0.02	% retained on sieve	Wet	63.2
S42-OC-22	Sieve 4	1.6	% retained on sieve	Wet	63.2
S42-OC-22	Sieve 10	7.3	% retained on sieve	Wet	63.2
S42-OC-22	Sieve 16	7.1	% retained on sieve	Wet	63.2
S42-OC-22	Sieve 35	9.4	% retained on sieve	Wet	63.2
S42-OC-22	Sieve 50	12.3	% retained on sieve	Wet	63.2
S42-OC-22	Sieve 100	37.6	% retained on sieve	Wet	63.2
S42-OC-22	Sieve 200	10.0	% retained on sieve	Wet	63.2
S42-OC-22	Sieve bottom plate	2.0	% retained on sieve	Wet	63.2
S43-OC-23	Sieve 3/8	16.6	% retained on sieve	Wet	58.8
S43-OC-23	Sieve 4	5.0	% retained on sieve	Wet	58.8
S43-OC-23	Sieve 10	4.2	% retained on sieve	Wet	58.8
S43-OC-23	Sieve 16	3.7	% retained on sieve	Wet	58.8
S43-OC-23	Sieve 35	10.3	% retained on sieve	Wet	58.8
S43-OC-23	Sieve 50	8.1	% retained on sieve	Wet	58.8
S43-OC-23	Sieve 100	7.6	% retained on sieve	Wet	58.8
S43-OC-23	Sieve 200	16.1	% retained on sieve	Wet	58.8
S43-OC-23	Sieve bottom plate	7.5	% retained on sieve	Wet	58.8

TABLE B-8
SEDIMENT GRAIN SIZE ANALYSIS AND PERCENT SOLIDS
DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

Sample Name	Analyte	Result	Units	Basis	Percent Solids
S44-OC-24	Sieve 3/8	0.0	% retained on sieve	Wet	70.5
S44-OC-24	Sieve 4	0.3	% retained on sieve	Wet	70.5
S44-OC-24	Sieve 10	1.1	% retained on sieve	Wet	70.5
S44-OC-24	Sieve 16	1.0	% retained on sieve	Wet	70.5
S44-OC-24	Sieve 35	1.6	% retained on sieve	Wet	70.5
S44-OC-24	Sieve 50	2.6	% retained on sieve	Wet	70.5
S44-OC-24	Sieve 100	13.4	% retained on sieve	Wet	70.5
S44-OC-24	Sieve 200	36.0	% retained on sieve	Wet	70.5
S44-OC-24	Sieve bottom plate	12.0	% retained on sieve	Wet	70.5
S45-OC-25	Sieve 3/8	5.7	% retained on sieve	Wet	58.1
S45-OC-25	Sieve 4	12.8	% retained on sieve	Wet	58.1
S45-OC-25	Sieve 10	12.8	% retained on sieve	Wet	58.1
S45-OC-25	Sieve 16	5.4	% retained on sieve	Wet	58.1
S45-OC-25	Sieve 35	10.5	% retained on sieve	Wet	58.1
S45-OC-25	Sieve 50	8.2	% retained on sieve	Wet	58.1
S45-OC-25	Sieve 100	14.8	% retained on sieve	Wet	58.1
S45-OC-25	Sieve 200	0.5	% retained on sieve	Wet	58.1
S45-OC-25	Sieve bottom plate	11.6	% retained on sieve	Wet	58.1
S46-OC-26	Sieve 3/8	0.0	% retained on sieve	Wet	58.9
S46-OC-26	Sieve 4	0.02	% retained on sieve	Wet	58.9
S46-OC-26	Sieve 10	1.7	% retained on sieve	Wet	58.9
S46-OC-26	Sieve 16	3.6	% retained on sieve	Wet	58.9
S46-OC-26	Sieve 35	8.2	% retained on sieve	Wet	58.9
S46-OC-26	Sieve 50	9.9	% retained on sieve	Wet	58.9
S46-OC-26	Sieve 100	10.5	% retained on sieve	Wet	58.9
S46-OC-26	Sieve 200	10.2	% retained on sieve	Wet	58.9
S46-OC-26	Sieve bottom plate	3.1	% retained on sieve	Wet	58.9

APPENDIX C
DATA VALIDATION REPORTS

MEMORANDUM

Date: June 27, 2007

To: Jack Brunner, Project Manager, SulTRAC
Remedial Action Contract (RAC 2) for Region 5

From: Lea Cole, Environmental Scientist, SulTRAC

Subject: Data Validation for
Duck and Otter Creeks, Toledo and Oregon, Ohio
WA No. 014-ANLA-5201

Laboratory: Severn Trent Laboratories Inc. (STL)
Sample Delivery Group 119431
Analysis of 16 sediment samples for acid volatile sulfide (AVS), simultaneously extracted metals (SEM), and polynuclear aromatic hydrocarbons (PAH)

1.0 INTRODUCTION

SulTRAC validated AVS/SEM and PAH analytical data for 16 sediment samples collected during field activities conducted from April 2 through April 5, 2007, at the Duck and Otter Creeks site located in Toledo and Oregon, Ohio. The 16 sediment samples were analyzed by STL Laboratories, Inc., located in South Burlington, Vermont, using (1) the guidelines in the U.S. Environmental Protection Agency (U.S. EPA) "Draft Analytical Method for Determination of Acid Volatile Sulfide in Sediment," and SW-846 Methods 6010B and 7470A for AVS/SEM preparation and analysis, and (2) SW-846 Method 3550B for PAH extraction followed by analysis for PAHs in accordance with a method published by the National Oceanic and Atmospheric Administration (NOAA). The NOAA PAH method uses the isotope dilution variant of gas chromatography/mass spectrometry (GC/MS).

The data were validated in general accordance with U.S. EPA's "Contract Laboratory Program National Functional Guidelines for Organic Data Review," dated October 1999, and "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," dated October 2004.

Organic data validation consisted of a review of the following quality control (QC) parameters:

- Holding times
- Instrument performance checks
- Initial and continuing calibrations
- Method blank analysis
- Surrogate spike recoveries
- Matrix spike and matrix spike duplicate (MS/MSD) recoveries
- Laboratory control sample (LCS) recoveries
- Internal standard area counts and retention times
- Field duplicate analysis
- Laboratory duplicate analysis
- Target detection limits
- Target compound identification and quantitation

Inorganic data validation consisted of a review of the following QC parameters:

- Holding times
- Initial and continuing calibrations
- Method blank analysis
- Inductively coupled plasma – interference check sample (ICP-ICS) results
- MS/MSD recoveries
- LCS recoveries
- Laboratory duplicate analysis
- Serial dilution results
- Sample results quantitation

Section 2.0 and Section 3.0 discuss the results of the organic and inorganic data validation. Section 4.0 presents an overall assessment of the data. The attachment to this memorandum contains the “Contract Laboratory QA/QC Analysis Checklist for Sediment Chemistry Analysis” for each of the analyses.

2.0 ORGANICS DATA VALIDATION RESULTS

The results of SulTRAC's organic data validation are summarized below in terms of the QC parameters reviewed. The Great Lakes National Program Office (GLNPO) data qualifiers below were applied to the analytical results where warranted.

- J – Estimated value; greater than detection limit, but less than reporting limit
- MS – Estimated value; relative percent difference (RPD) between MS/MSD exceeded specified criteria
- IS – Estimated value; internal standard recoveries are outside the upper or lower control limits
- U – Analyte not detected at or above reporting limit

2.1 HOLDING TIMES

Holding time requirements for PAH analysis of sediment samples are extraction within 14 days after the sample is collected and analysis within 40 days of extraction. Sediment samples to be analyzed for PAHs were extracted within 5 days after samples were collected, and the extract was analyzed within 26 days of extraction. No discrepancies were noted.

2.2 INSTRUMENT PERFORMANCE CHECKS

The instrument performance checks were performed with decafluorotriphenylphosphine (DFTPP) as required for analysis of PAHs. No discrepancies were noted.

2.3 INITIAL AND CONTINUING CALIBRATIONS

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative results. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification establishes that the initial calibration is still valid by checking the performance of

the instrument on a continuous basis throughout the analytical process. Initial and continuing calibrations for PAHs analyses were within established QC limits. No discrepancies were noted.

2.4 METHOD BLANK ANALYSIS

The purpose of method blank analysis is to assess the existence and magnitude of contamination that resulted from laboratory activities. No discrepancies were noted.

2.5 SURROGATE SPIKE RECOVERY RESULTS

Laboratory performance on individual samples is established by fortifying each sample with surrogate compounds. Surrogate compounds included naphthalene-d8, acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12. All surrogate recoveries were within QC limits.

2.6 MS/MSD RECOVERY AND RPD RESULTS

MS/MSD samples are analyzed to evaluate the long-term precision and accuracy of the analytical method and to demonstrate acceptable compound recovery by the laboratory. Sediment sample OC-SED-26 was analyzed for MS/MSD. High levels of PAHs were detected in sample OC-SED-26, so the sample was analyzed at a 50-times dilution; therefore, recoveries of the spiked compounds could not be reliably determined. The RPD results for analysis of PAHs fell outside the QC limit of 40 percent for 14 of 18 spiked compounds. This indicates significant heterogeneity in the distribution of the PAHs within sample OC-SED-26, and all results for this sample were qualified "MS." Similar heterogeneities may exist in other samples.

2.7 LCS RECOVERY RESULTS

Data for LCSs are generated to provide information on the accuracy of the analytical method and on the laboratory performance. All LCS recovery results were within QC limits.

2.8 INTERNAL STANDARD AREA COUNTS AND RETENTION TIMES

Internal standards (IS) performance criteria ensure that GC/MS sensitivity and response are stable during each analysis. Internal standard area counts must not vary more than 30 percent (-30 percent to +30 percent) from the associated 12-hour calibration standard. The IS compounds used were fluorene-d10, benzo(a)pyrene-d12, naphthalene-d8, acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12. Internal standard area counts were low for perylene-d12 in the laboratory method blank sample (MBLK40707B). Internal standard area counts were low for naphthalene-d8, acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12 in sediment samples DC-SED-01, DC-SED-03, DC-SED-05, and DC-SED-08. The results for all detect and nondetect analytes quantitated using the low IS recoveries were qualified as estimated ("IS") for those samples. No discrepancies were noted in retention times.

2.9 FIELD DUPLICATE ANALYSIS

In accordance with the approved quality assurance project plan and field sampling plan (QAPP/FSP), field duplicates were not collected for the sediment samples.

2.10 LABORATORY DUPLICATE ANALYSIS

Laboratory duplicate sample RPD results for PAH analysis were not provided in the data package from this project. However, the MS/MSD analysis discussed above serves as a laboratory duplicate analysis. No action was taken to qualify analytical data.

2.11 TARGET DETECTION LIMITS

Target detection limits were elevated for the PAH analysis for sediment samples. High concentrations of analytes in the sediment samples required dilution of sample extracts, which raised the detection limits. In addition, the percent moisture in individual samples varied, increasing detection limits because sample results were adjusted for dry-weight concentrations. The overall quality data was not affected by the necessary sample dilutions, but data users should note that some non-detected compounds have reporting limits above the ecological reference limits specified in the QAPP.

2.12 TARGET COMPOUND IDENTIFICATION AND QUANTITATION

The objective for GC/MS qualitative analysis is to minimize erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present). The objective of the criteria for GC/MS quantitative analysis is to ensure that the reported quantitation results and contract-required quantitation limits (CRQLs) are accurate.

Target compounds identification was properly done by retention time and mass spectra. Quantitation was properly done, including use of manual integration to minimize interference from overlapping peaks. Results were properly calculated and corrected to dry weight.

3.0 INORGANICS DATA VALIDATION RESULTS

The results of SulTRAC's inorganic data validation are summarized below in terms of the QC parameters reviewed. The GLNPO data qualifiers below were applied to the analytical results where warranted.

- J – Estimated value; greater than detection limit, but less than reporting limit
- M – Estimated value; associated MS/MSD recoveries exceed the upper or lower control limits
- MS – Estimated value; RPD between MS/MSD exceeded specified criteria
- SD – Estimated value; serial dilution exceeds specified criteria
- U – Analyte not detected at or above reporting limit

3.1 HOLDING TIMES

The holding time requirement for metals in sediment samples is within 6 months after samples are collected for both preparation and analysis. Sediment samples for analysis of metals were prepared within 9 days after samples were collected and were analyzed within 26 days after samples were collected. The holding time requirement for mercury in sediment samples is within 28 days of collection for both preparation and analysis. Sediment samples for analysis of mercury were prepared within 9 days

after sample collection and were analyzed within 23 days of sample collection. The holding time requirement for AVS analysis is within 28 days of collection for both preparation and analysis of sediment samples. Sediment samples for AVS analysis were prepared and analyzed within 9 days after samples were collected. No discrepancies were noted.

3.2 INITIAL AND CONTINUING CALIBRATIONS

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative results. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification establishes that the initial calibration is still valid by checking the performance of the instrument on a continuous basis throughout the analysis process. Initial and continuing calibrations for analysis of metals were within established QC limits. For the AVS analysis, calibration consists of standardization of the titrants, which was done correctly a few days before analysis. No discrepancies were noted.

3.3 METHOD BLANK ANALYSIS

The results for all preparation blanks for AVS analysis were not detected. Cadmium was reported at 0.6 micrograms per liter ($\mu\text{g/L}$) for the initial calibration blank sample. No sample results were qualified because field samples were not analyzed between the initial calibration blank and the first continuing calibration blank, and cadmium was not detected in the continuing calibration blank. Zinc was reported at 0.030 micromoles per gram ($\mu\text{mole/g}$) in the preparation blank sample. All sediment sample results for zinc were greater than 5 times the level detected in the preparation blank; therefore, no results were qualified.

3.4 INTERFERENCES CHECK SAMPLE (ICS) RECOVERIES

The ICP-ICS verifies the contract laboratory's inter-element and background correction factors. All results for analysis of metals were within the QC limits. No discrepancies were noted. ICSs are not required for AVS analysis.

3.5 MS/MSD RECOVERY AND RPD RESULTS

MS/MSD samples are analyzed to evaluate long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory. Sediment sample OC-SED-26 was analyzed for MS/MSD. MS/MSD percent recoveries for mercury and silver were below the 75 percent lower QC limit. The post-digestion spike for sediment sample OC-SED-26 and the laboratory control sample were within the QC limits, which confirms that the low recovery is due to matrix interference. Nondetected results for mercury and silver in all samples were qualified as estimated, “U, M,” because of the potential low bias.

The RPD for silver in the MS/MSD analysis for sediment sample OC-26-SED was greater than the QC criterion of 20 percent; RPDs for all other metals were within control limits. The nondetected results for silver in all sediment samples were qualified as estimated, “U, MS,” because of the high RPD.

MS/MSD percent recoveries for AVS were below the 85 percent lower QC limit; both analyses gave identical recoveries and the RPD was within QC limits. The results for AVS in all sediment samples were qualified as estimated “M” because of the low MS/MSD recoveries.

3.6 LCS RECOVERY RESULTS

Data for LCS are generated to provide information on the accuracy of the analytical method and on the laboratory performance. All LCS recovery results were within QC limits.

3.7 LABORATORY DUPLICATE ANALYSIS

The purpose of duplicate sample analysis is to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate analyses are also used to generate data that evaluates the long-term precision of the analytical method. Duplicate data for metal analyses were obtained from the MS/MSD analysis of sediment sample OC-SED-26. No discrepancies were noted for the AVS laboratory duplicate analysis.

3.8 SERIAL DILUTION RESULTS

The serial dilution of samples quantitated by ICP indicates whether significant physical or chemical interferences exist as a result of the sample matrix. The percent difference for zinc serial dilution results on sediment sample OC-SED-26 was outside the QC limit of 10 percent. The detected results for zinc in all samples were qualified as estimated, “SD,” because of the potential matrix effects.

3.9 SAMPLE RESULTS QUANTITATION

The calculations of a few results were verified and found to be performed correctly. Sediment results were corrected to dry weight.

4.0 DATA ASSESSMENT

The analytical results meet the data quality objectives defined by the applicable method and validation guidance, the specific method requirements, and the QAPP. Overall, the sample analytical data generated by STL are acceptable for use as qualified. The high concentrations of PAHs in some samples required dilutions that brought some reporting limits above the risk-based limits specified in the QAPP. Because other analytes were well above those limits, this would not significantly impact use of the data for decision making.

ATTACHMENT
CONTRACT LABORATORY QA/QC ANALYSIS CHECKLISTS
FOR SEDIMENT CHEMISTRY ANALYSIS
(Six Pages)

Contract Lab QA/QC Analysis Checklist for SEDIMENT CHEMISTRY ANALYSIS

GRANT/IAG NUMBER: Not Applicable
PROJECT NAME: Duck and Otter Creeks Site, Sample Delivery Group 119431
REVIEWER: Lea Cole
DATE: 06/27/07

1. What sediment chemistry data has been collected (CHECK ALL THAT APPLY)?

<input type="checkbox"/> Total Metals	<input type="checkbox"/> PCBs	<input type="checkbox"/> pH	<input type="checkbox"/> TOC
<input type="checkbox"/> Dioxins/Furans	<input checked="" type="checkbox"/> PAHs	<input type="checkbox"/> Pesticides	<input type="checkbox"/> DO
<input type="checkbox"/> SEM Metals	<input type="checkbox"/> Particle Size	<input type="checkbox"/> AVS	<input type="checkbox"/> Other

2. Were the target detection limits met for each parameter?

YES
NO ☒ (UNACCEPTABLE)

3. Were the Method Blanks less than the established MDL for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

4. Did the results of Field Duplicate Analysis vary by less than the % RPD specified in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

5. Did the results of the Field Replicates Analysis vary by less than the % RPD specified in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

6. Did the surrogate spike recoveries meet the limits set forth in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

7. Did the MS/MSD recoveries meet the limits set forth in the QAPP?

YES
NO ☒ (UNACCEPTABLE)

8. Did the RPD (%) of the MS/MSD sample set meet the limits set forth in the QAPP?

YES
NO X (UNACCEPTABLE)

9. Did the initial calibration verification standards meet the requirements set forth in the QAPP?

YES X
NO _____ (UNACCEPTABLE)

10. Did all required analysis take place within the required holding time protocols set forth in the QAPP?

YES X
NO _____ (UNACCEPTABLE)

11. Did the laboratory duplicates vary by less than the % RPD specified in the QAPP?

YES NA
NO NA (UNACCEPTABLE)

12. Are measured dry weight contaminant concentrations reported? (Note: Conversion from wet weight to dry weight concentration may occur ONLY if data on moisture or TOC are provided. Nominal concentrations are unacceptable.)

YES X
NO _____ (UNACCEPTABLE)

13. Please provide details for all of the "UNACCEPTABLE" marked above. Include details on the specific analytes affected by any QA/QC discrepancies, and recommendations regarding usability of data.

Item 2: Target detection limits were elevated for the polynuclear aromatic hydrocarbon (PAH) analysis for sediment samples. High concentrations of analytes in the samples required dilution of sample extracts, which raised the detection limits. In addition, the percent moisture in individual samples varied, increasing detection limits because sample results were adjusted for dry-weight concentrations. The overall quality data was not affected by the necessary sample dilutions, but data users should note that some non-detected compounds have reporting limits above the ecological reference limits specified in the QAPP.

Item 7: Sediment sample OC-SED-26 was analyzed for MS/MSD. High levels of PAHs were detected in this sample, so the sample was analyzed at a 50-times dilution; therefore, recoveries of the spiked compounds could not be reliably determined. However, no data qualifiers were added to sample results.

Item 8: The RPD results for analysis of PAHs in the MS/MSD sample (OC-SED-26) fell outside the QC limit of 40 percent for 14 of 18 spiked compounds. This indicates significant heterogeneity in the distribution of the PAH within sample OC-SED-26, and all results for this sample were qualified “MS.” Similar heterogeneities may exist in other samples.

Additional Item: Internal standard area counts were low for naphthalene-d8, acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12 in sediment samples DC-SED-01, DC-SED-03, DC-SED-05, and DC-SED-08. The results for all detected and nondetected analytes quantitated using the low IS recoveries were qualified as estimated (“IS”) for those samples.

Items not applicable (NA): In accordance with the approved quality assurance project plan (QAPP) and field sampling plan (FSP), field duplicate and field replicate samples were not required for this project (Items 4 and 5). Laboratory duplicate samples were not analyzed, but the MS/MSD analysis discussed above serves as a laboratory duplicate analysis (Item 11).

Contract Lab QA/QC Analysis Checklist for SEDIMENT CHEMISTRY ANALYSIS

GRANT/IAG NUMBER: Not Applicable
PROJECT NAME: Duck and Otter Creeks Site, Sample Delivery Group 119431
REVIEWER: Lea Cole
DATE: 06/27/07

1. What sediment chemistry data has been collected (CHECK ALL THAT APPLY)?

<input type="checkbox"/> Total Metals	<input type="checkbox"/> PCBs	<input type="checkbox"/> pH	<input type="checkbox"/> TOC
<input type="checkbox"/> Dioxins/Furans	<input checked="" type="checkbox"/> PAHs	<input type="checkbox"/> Pesticides	<input type="checkbox"/> DO
<input checked="" type="checkbox"/> SEM Metals	<input type="checkbox"/> Particle Size	<input checked="" type="checkbox"/> AVS	<input type="checkbox"/> Other

2. Were the target detection limits met for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

3. Were the Method Blanks less than the established MDL for each parameter?

YES ☐
NO ☒ (UNACCEPTABLE)

4. Did the results of Field Duplicate Analysis vary by less than the % RPD specified in the QAPP?

YES ☐ NA
NO ☒ (UNACCEPTABLE)

5. Did the results of the Field Replicates Analysis vary by less than the % RPD specified in the QAPP?

YES ☐ NA
NO ☒ (UNACCEPTABLE)

6. Did the surrogate spike recoveries meet the limits set forth in the QAPP?

YES ☐ NA
NO ☒ (UNACCEPTABLE)

7. Did the MS/MSD recoveries meet the limits set forth in the QAPP?

YES ☐
NO ☒ (UNACCEPTABLE)

8. Did the RPD (%) of the MS/MSD sample set meet the limits set forth in the QAPP?

YES
NO X (UNACCEPTABLE)

9. Did the initial calibration verification standards meet the requirements set forth in the QAPP?

YES X
NO _____ (UNACCEPTABLE)

10. Did all required analysis take place within the required holding time protocols set forth in the QAPP?

YES X
NO _____ (UNACCEPTABLE)

11. Did the laboratory duplicates vary by less than the % RPD specified in the QAPP?

YES X
NO _____ (UNACCEPTABLE)

12. Are measured dry weight contaminant concentrations reported? (Note: Conversion from wet weight to dry weight concentration may occur ONLY if data on moisture or TOC are provided. Nominal concentrations are unacceptable.)

YES X
NO _____ (UNACCEPTABLE)

13. Please provide details for all of the "UNACCEPTABLE" marked above. Include details on the specific analytes affected by any QA/QC discrepancies, and recommendations regarding usability of data.

Item 3: Cadmium was reported at a concentration of 0.6 micrograms per liter ($\mu\text{g/L}$) for the initial calibration blank sample. No sample results were qualified because field samples were not analyzed between the initial calibration blank and the first continuing calibration blank, and cadmium was not detected in the continuing calibration blank. Zinc was reported at a concentration of 0.030 micromoles per gram ($\mu\text{mole/g}$) in the preparation blank sample. All sediment sample results for zinc were greater than five times the level detected in the preparation blank; therefore, no results were qualified.

Item 7: Sediment sample OC-SED-26 was analyzed for MS/MSD, and percent recoveries for mercury and silver were below the 75 percent lower QC limit. The post-digestion spike for sediment sample OC-SED-26 and the laboratory control sample were within the QC limits, confirming that the low recovery is due to matrix interference. Nondetected results for mercury and silver in all samples were qualified as estimated, "U, M," because of the potential low bias.

MS/MSD percent recoveries for AVS were below the 85 percent lower QC limit; the results for AVS in all sediment samples were qualified as estimated "M" because of the low MS/MSD recoveries.

Item 8: The RPD for silver in the MS/MSD analysis for sediment sample OC-26-SED was greater than the QC criterion of 20 percent; RPDs for all other metals were within control limits. The nondetected results for silver in all sediment samples were qualified as estimated, “U, MS,” because of the high RPD.

Additional Item: The percent difference for zinc serial dilution results on sediment sample OC-SED-26 was outside the QC limit of 10 percent. The detected results for zinc in all samples were qualified as estimated, “SD,” because of the potential matrix effects.

Items not applicable (NA): In accordance with the approved quality assurance project plan (QAPP) and field sampling plan (FSP), field duplicate and field replicate samples were not required for this project (Items 4 and 5). Surrogate spikes are not required for AVS/SEM analyses (Item 6).

MEMORANDUM

Date: August 29, 2007

To: Jack Brunner, Project Manager, SulTRAC
Remedial Action Contract (RAC 2) for Region 5

From: Christopher Ohland, Environmental Scientist, SulTRAC

Subject: Data Validation for
Duck and Otter Creeks, Toledo and Oregon, Ohio
WA No. 014-ANLA-5201

Laboratory: EPA Region 5 Central Region Laboratory
Work Order No. 0704009

Analysis of 46 sediment samples and 2 equipment rinsate samples for polynuclear aromatic hydrocarbons (PAHs), organochlorine pesticides, polychlorinated biphenyls (PCB), total metals, total organic carbon (TOC), oil and grease (O&G), and grain size

1.0 INTRODUCTION

SulTRAC validated the analytical data for polynuclear aromatic hydrocarbons (PAHs), organochlorine pesticides, polychlorinated biphenyls (PCB), total metals, total organic carbon (TOC), oil and grease (O&G), and grain size of 46 sediment samples and 2 equipment rinsate samples. These samples were collected during field activities conducted from April 2 through April 5, 2007, at the Duck and Otter Creeks site located in Toledo and Oregon, Ohio. The samples were analyzed by the U.S. Environmental Protection Agency (EPA) Central Regional Laboratory (CRL) in Chicago, Illinois, using the standard operating procedures (SOPs) described in the quality assurance project plan and field sampling (QAPP/FSP) (SulTRAC, March 28, 2007).

The data were validated in general accordance with U.S. EPA's "Contract Laboratory Program National Functional Guidelines for Organic Data Review," dated October 1999, and "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," dated October 2004.

Organic data validation consisted of a review of the following quality control (QC) parameters:

- Holding times
- Instrument performance checks
- Initial and continuing calibrations
- Method and field blank analysis
- Surrogate spike recoveries
- Matrix spike and matrix spike duplicate (MS/MSD) recovery and relative percent difference (RPD) results
- Laboratory control sample (LCS) recoveries
- Internal standard area counts and retention times
- Field duplicate analysis
- Laboratory duplicate analysis
- Target detection limits
- Target compound identification and quantitation

Inorganic data validation consisted of a review of the following QC audits:

- Holding times
- Initial and continuing calibrations
- Method and field blank analysis
- Inductively coupled plasma — interference check sample (ICP-ICS)
- MS/MSD recovery and RPD results
- LCS recoveries
- Laboratory duplicate analysis
- Serial dilution results (not evaluated)
- Sample result quantitation

Section 2.0 and Section 3.0 discuss the results of the organic and inorganic data validation for each analytical fraction. Section 4.0 presents an overall assessment of the data. The attachment to this memorandum contains the “Contract Laboratory QA/QC Analysis Checklist for Sediment Chemistry Analysis” for each of the analyses.

2.0 ORGANICS DATA VALIDATION RESULTS

The results of SulTRAC's organic data validation are summarized below in terms of the QC parameters reviewed. The following standard and Great Lakes National Program Office (GLNPO) data qualifiers below were applied to the sample analytical results where warranted.

- J – Estimated value; greater than detection limit but less than reporting limit
- CV – Estimated value; calibration verification results exceed upper or lower control limits
- H – Estimated value; holding time exceeded
- LC – Estimated value; laboratory control recoveries exceed upper or lower control limits
- LS – Estimated value; batch quality control for laboratory surrogates exceeds upper or lower control limits
- M – Estimated value; associated MS/MSD recoveries exceed the upper or lower control limits
- MS – Estimated value; RPD between MS/MSD exceeded specified criteria
- U – Analyte not detected at or above reporting limit
- R – Result is rejected; analyte may or may not be present

2.1 POLYNUCLEAR AROMATIC HYDROCARBON ANALYSIS

2.1.1 HOLDING TIMES

The holding time requirement for analysis of PAHs in sediment samples is within 14 days after the sample is collected for extraction and analysis within 40 days of extraction. The following sample batches were prepared.

- Batch 074046: Samples 0704009-01 through -15 (Includes MB, LCS, and MS pair)
- Batch 074047: Samples 0704009-16 through -33 (Includes, MB, LCS, and MS pair)
- Batch 074048: Samples 0704009-21RE replaces original extract though reason is not documented, 0704009-34 through -40 (Includes, MB, LCS, and MS pair)
- Batch 074049: Samples 0704009-41 through -46 (Includes, MB, LCS, and MS pair)
- Batch 074050: Samples 0704009-47 and -48 (No MB, LCS pair, or MS pair)
- Batch 075035: Samples 0704009-23RE through -30RE (Includes MB, LCS pair, and MS pair)

Sample holding times were met except for samples S23-OC-04, S24-OC-05, S25-OC-06, S26-OC-07, S27-OC-08, S28-OC-09, S29-OC-10, and S30-OC-11. The laboratory believes it omitted adding a surrogate solution to some of the samples assigned to batch 074047. The samples were re-extracted (holding time ranged from 55 to 57 days) outside of the EPA-recommended holding time of 14 days. Both data sets were reported. Most of the samples contained detectable amounts of PAHs; however, the accuracy and precision of the data set are unknown for the original sample extracts and are assumed to be biased low for the re-extraction because sample quality may have degraded in the re-extracted data set. The re-extracted sample set is preferred for use over the original data set because PAH degradation in a laboratory-refrigerated environment is expected to be minimal. The original dataset is qualified as rejected and flagged "R." The re-extracted data set is qualified as an estimate and is flagged "H" or "U, H", as appropriate. Samples S47-ER-EK-01 and S48-ER-SH-02 were analyzed (holding time 42 days) outside of the EPA-recommended holding time for extracts of 40 days. Target compounds were absent from these field rinsate samples, and the non-detected results are qualified as estimates and are flagged "U, H."

2.1.2 INSTRUMENT PERFORMANCE CHECKS

The instrument performance checks were performed with decafluorotriphenylphosphine (DFTPP) as required for analysis of PAHs. No discrepancies were noted.

2.1.3 INITIAL AND CONTINUING CALIBRATIONS

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative results. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification (CCV) establishes that the initial calibration is still valid by checking the performance of the instrument on a continuous basis throughout the analysis process. Initial calibration and continuing calibration standard results for analysis of PAHs were within established QC limits. Minor CCV QC deficiencies were observed for indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. Samples associated with the deficient calibrations were qualified as estimates and

were flagged “J” if detected, and “UJ” if not detected. The following results were qualified “CV” or “U, CV”, as appropriate.

- Benzo(g,h,i)perylene: S12-DC-12, S13-DC-13, S14-DC-14, S15-DC-15, S16-DC-16, S17-DC-17, S18-DC-18, S19-DC-19, S20-OC-01, S21-OC-02, and S22-OC-03
- Indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene: S31-OC-12, S32-OC-13, and S33-OC-14
- Indeno(1,2,3-cd)pyrene and benzo(g,h,i)perylene: S29-OC-10 and S30-OC-11

2.1.4 METHOD AND FIELD BLANK ANALYSIS

The purpose of laboratory method blank and field equipment rinsate blank analysis is to evaluate the existence and magnitude of contamination that resulted from laboratory and field activities. No discrepancies were noted.

2.1.5 SURROGATE SPIKE RECOVERY RESULTS

Laboratory performance on individual samples is established by fortifying each sample with surrogate compounds. Surrogate compounds included nitrobenzene-d5, 2-fluorobiphenyl, and terphenyl-d14.

All surrogate compounds were recovered within the expected control limits, except samples S11-DC-11 and S21-OC-02, where recovery for one of the three base/neutral surrogates was below the lower control limit. Deficiencies were also noted for samples S33-OC-14 and S42-OC-22, where recovery for one of the three base/neutral surrogates was above the upper control limit. No action was needed to qualify the data when one surrogate fails but the others are acceptable. The laboratory believes that the surrogate cocktail was not fortified in samples S23-OC-04, S25-OC-05, S25-OC-06, S25-OC-07, S25-OC-08, S25-OC-09, S25-OC-10, and S25-OC-11. These samples were re-extracted outside of the EPA-recommended holding time and reported as described previously.

2.1.6 MS/MSD RECOVERY AND RPD RESULTS

Data for MS/MSD are generated to evaluate long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory when the sample is analyzed. Five samples (more than requested) were analyzed for MS/MSD, including S10-DC-10, S20-OC-01, S39-OC-20, S30-OC-11, and S46-OC-26.

An MS/MSD pair was included with every extraction batch except the aqueous field QC samples. In all cases, native levels of PAHs were present that interfered with the concentration of the fortified PAHs. Higher concentrations in the fortified spike would have been more appropriate. With the exception of benzo(g,h,i)perylene, the lowest recovery was 24.7 percent and the highest recovery was within the established control limits. The MS and MSD data are similar to the laboratory control sample performance and do not provided a conclusive assessment that matrix accuracy or precision is compromised. No action was taken to qualify the data based on the MS/MSD results. The MS samples associated with batch 074046 and 074047 reported zero or low benzo(g,h,i)perylene recovery that was attributed to a malfunctioning gel permeation chromatography (GPC) fractionation procedure. A subset of these samples was re-extracted as a result of surrogate deficiencies, but was not run through the GPC.

Results for benzo(g,h,i)perylene are qualified as rejected and flagged “R” and “M” in the following samples: S01-DC-01, S02-DC-02, S03-DC-03, S04-DC-04, S05-DC-05, S06-DC-06, S07-DC-07, S08-DC-08, S09-DC-09, S10-DC-10, S11-DC-11, S12-DC-12, S13-DC-13, S14-DC-14, S15-DC-15, S16-DC-16, S17-DC-17, S18-DC-18, S19-DC-19, S20-OC-01, S22-OC-03, S31-OC-12, S32-OC-13, and S33-OC-14. Results for benzo(g,h,i)perylene in samples originally in these extraction batches but later re-extracted are not qualified here, but are discussed elsewhere under holding time.

2.1.7 LCS RECOVERY RESULTS

Data for LCSs are generated to provide information on the accuracy of the analytical method and on the laboratory's performance.

The laboratory control samples were used to assess the accuracy of the extraction batches associated with this sample delivery group, except batch 074050 (aqueous field QC samples). With the exception of benzo(g,h,i)perylene, the lowest recovery was 62.9 percent and the highest recovery was 110 percent. Performance of the laboratory control sample recoveries is similar to the MS/MSD pairs, although the overall recovery values are improved in the absence of native target compounds. The LCSs associated with batch 074046 and 074047 showed zero benzo(g,h,i)perylene recovery that was attributed to a malfunctioning GPC fractionation procedure. Low benzo(g,h,i)perylene recoveries were also observed with field sample batches 074048 and 070449. Samples assigned to batches 074050 and 075035 were not run through the GPC clean up process. Because of the widespread deficiency, benzo(g,h,i)perylene results for all field samples associated with batches 074046, 074047, 074048, and 074049 are qualified as rejected and flagged “R, LC.”

2.1.8 INTERNAL STANDARD AREA COUNTS AND RETENTION TIMES

Internal standards (IS) performance criteria ensure that gas chromatography/ mass spectrometry (GC/MS) sensitivity and response are stable during each analysis. IS area counts must not vary more than minus 50 and plus 200 percent from the associated 12-hour calibration standard. The IS compounds used were 1,4-dichlorobenzene-d4, naphthalene-d8, acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12.

The internal standard recoveries were not acceptable for samples S33-OC-14, S42-OC-22, S43-OC-23, S44-OC-24, S45-OC-25, S47-ER-EK-01, and S48-ER-SH-02. The recoveries for these samples exceed the upper control limit for all six internal standards, except S42-OC-22 and S43-OC-23, where four and internal standards were deficient. The laboratory attributed this problem to an intermittent GC error allowed aliquot injections at a different sample volume than the calibration standards. Samples were re-injected successfully and the reported results are from the reinjections. No discrepancies were noted in retention times. Therefore, no qualifications are warranted.

2.1.9 FIELD DUPLICATE ANALYSIS

In accordance with the approved QAPP/FSP, field duplicates were not collected for the sediment samples.

2.1.10 LABORATORY DUPLICATE ANALYSIS

Laboratory duplicate samples are not required for the PAH analysis.

2.1.11 TARGET DETECTION LIMITS

Target detection limits were elevated for the analysis of PAHs in sediment samples. The low percent solids in individual samples increased detection limits because sample results were adjusted for dry-weight concentrations. Data users should note that some non-detected compounds have detection limits above the ecological reference limits specified in the QAPP due to the inherent limits of this analysis compounded by the low percent solids in some samples.

2.1.12 TARGET COMPOUNDS IDENTIFICATION AND QUANTITATION

The objective of the criteria for GC/MS qualitative analysis is to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present). The objective of the criteria for GC/MS quantitative analysis is to ensure that the reported quantitation results and contract required quantitation limits (CRQLs) are accurate.

Bench notes indicate problems with peak tailing and splitting that affected quantification of naphthalene and, to a lesser extent, methylnaphthalene. Manual integration was used to override the problematic chromatography. Review of the raw data, including these manual integrations and the mass spectra, showed that PAH were properly identified and quantitated. No further qualifications are warranted.

2.1.13 OTHER ISSUES

Sample S23-OC-04 was analyzed 4 minutes outside of the 12-hour tune window. The laboratory reported the sample data with a justification that the following instrument tune occurred soon after the sample extract was analyzed. No qualifications are warranted for this minor irregularity.

2.2 ORGANOCHLORINE PESTICIDES

2.2.1 HOLDING TIMES

The holding time requirement for organochlorine pesticide analysis of sediment samples is extraction within 14 days after the sample is collected and analysis within 40 days of extraction. All samples were originally extracted within holding times.

Sample S11-DC-11 was re-extracted because the original extract was lost in the laboratory. The re-extraction occurred outside of the recommended holding time. The sample results are qualified as estimates and flagged “H” if detected, and “U, H” if non-detected.

The following sample batches were identified:

- B704040 (sediment samples for 0704009-01 to -19, and re-extraction of sample 0704009-11)
- B704037 (sediment samples for 0704009-20 to -33)
- B704045 (sediment samples for 0704009-34 to -46)
- B704033 (aqueous QC samples 0704009-47 and -48)

The laboratory prepared three solid sample extraction batches and one aqueous batch. Solid batches B704040 and B704045 were assigned a method blank only. Solid batch B704037 was assigned an MS/MSD pair, an LCS pair, and a method blank. Aqueous batch B704033 was assigned a method blank only.

2.2.2 INSTRUMENT PERFORMANCE CHECK

Pesticides were analyzed using a GC method, and instrument performance checks are not required.

2.2.3 INITIAL AND CONTINUING CALIBRATIONS

Initial and continuing calibrations and ongoing instrument performance were not acceptable for numerous reasons. Deficiencies in the initial and continuing calibrations were reported for primary and secondary columns including: signal 1 (delta-BHC; 4,4'-DDD; endosulfan II; endrin aldehyde; and endrin ketone) and signal 2 (heptachlor; 4,4'-DDT, and endrin ketone). It was not possible to readily identify the signal the laboratory used to quantify the organochlorine pesticide detections without additional information that was not provided in the data packages, so no qualifications were applied.

Resolution checks were not included as part of the laboratory's chromatographic assessment.

The laboratory reported DDT and endrin degradation deficiencies. Because the sample extracts were approaching EPA-recommended holding times, the laboratory decided to complete the analysis without performing a corrective action for the degradation deficiency. The laboratory indicated that the problem was addressed after the samples were analyzed.

In addition, the laboratory was unable to control interference with endrin aldehyde on signal 1 and with DDT on signal 2. The narrative justifies QC deficiencies for %RSD, calibration verification standards (CVS), QC checks, and degradation checks without corrective action on the interference.

The secondary column was used only for confirming identifications. The laboratory did not provide retention time summaries in the data package; thus, this QC element was not evaluated. No qualifications were made for this omission.

2.2.4 METHOD AND FIELD BLANK ANALYSIS

The purpose of laboratory method blank and field equipment rinsate analysis is to evaluate the existence and magnitude of contamination resulting from laboratory and field activities. No discrepancies were noted.

2.2.5 SURROGATE SPIKE RECOVERY RESULTS

Laboratory performance on individual samples is established by fortifying each sample with surrogate compounds. Surrogate compounds included tetrachloro-meta-xylene (TCMX) and dichlorobiphenyl (DCB).

The laboratory reported 19 instances where substantial co-elution interference prevented quantification of the DCB surrogate. For the following list of samples, TCMX surrogate recoveries were greater than the upper control limit and DCB could not be quantified because of the interferences. The data associated with these samples are qualified as estimated and are flagged “LS.” The sample list includes S21-OC-02, S22-OC-03, S23-OC-04, S24-OC-05, S25-OC-06, S26-OC-07, S27-OC-08, S28-OC-09, S32-OC-13, and S39-OC-20.

The surrogate spiking solution used in preparing batches B704037 and B704045 was 10 times lower than the amount listed in the SOP. Most of the low recovery responses were manually integrated to provide some level of quantification for the affected samples. With the exceptions noted in the previous paragraph, the quantitative results were within QC limits. No further qualifications are warranted.

2.2.6 MS/MSD RECOVERY AND RPD RESULTS

Field sample S20-OC-01 was used for the MS/MSD analysis. Project accuracy objectives were not met for 20 of the 38 fortified compounds, and precision objectives were not met for 14 of the 19 target compounds. Because of the widespread deficiency, all of the results associated with this sample are qualified as estimates and are flagged “M, MS” if detected, and “U, M, MS” if not detected. Two solid extraction batches did not include MS/MSD pairs as part of the laboratory QC audits. The laboratory

justifies this action in its policy to alternately fortify extraction batches with organochlorine pesticides one time and PCBs the next, which was the case for this project.

2.2.7 LCS RECOVERY RESULTS

LCS and LCS duplicate analyses were performed with batch B704037. Project accuracy objectives were not met for 22 of the 38 fortified compounds, and precision objectives were not met for four out of the 19 target compounds. Because of the widespread deficiency, all of the results associated with field samples in batch B704037 are qualified as estimates and are flagged “LC” if detected, and “U, LC” if not detected.

LCS and MS/MSD pairs were not extracted with samples from batch B704033 (aqueous samples 0704009-47 and 0704009-48), batch B704040 (sediment samples 0704009-01 to 0704009-19), and batch B704045 (sediment samples 0704009-34 to 0704009-46).

2.2.8 INTERNAL STANDARD AREA COUNTS AND RETENTION TIMES

ISs are not used with the organochlorine pesticide analysis.

2.2.9 FIELD DUPLICATE ANALYSIS

In accordance with the approved QAPP/FSP, field duplicates were not collected for the sediment samples.

2.2.10 LABORATORY DUPLICATE ANALYSIS

Laboratory duplicate samples are not required for the organochlorine pesticide analysis.

2.2.11 TARGET DETECTION LIMITS

Target detection limits were generally met for the organochlorine pesticide analysis for sediment samples, although the low percent solids in some individual samples increased detection limits because sample results were adjusted for dry-weight concentrations. Data users should note that some non-detected

compounds have reporting limits above the ecological reference limits specified in the QAPP due to the inherent capabilities of the analysis as well as the high water content of some samples.

2.2.12 TARGET COMPOUNDS IDENTIFICATION AND QUANTITATION

Organochlorine pesticide measurements are confirmed on a second instrument column and detector operating under a different set of instrument conditions. The measurement must appear within established retention times on both sets of instrument conditions for a target compound to be reported. Quantitation (from the primary column) and identification (from primary and secondary columns) were performed correctly, with some use of manual integration to remove overlapping peaks. Sediment results were corrected to dry weight.

2.3 POLYCHLORINATED BIPHENYLS

2.3.1 HOLDING TIMES

The holding time requirement for PCBs analysis of sediment samples is extraction within 14 days after the sample is collected and analysis within 40 days of extraction. Holding time requirements were met for the initial extractions of all compounds.

Sample S11-DC-11 was re-extracted because the original extract was lost in the laboratory. The re-extraction occurred outside of the recommended holding time. All non-detected results for this sample are qualified as estimates and are flagged “U, H.”

The following sample batches were identified:

- B704028 (sediment samples for 0704009-01 to -19 and the re-extraction of sample 0704009-11)
- B704042 (sediment samples for 0704009-20 to -33)
- B704044 (sediment samples for 0704009-34 to -46)
- B704034 (aqueous QC samples 0704009-47 and -48)

2.3.2 INSTRUMENT PERFORMANCE CHECKS

PCBs were analyzed using a GC method, and instrument performance checks are not required.

2.3.3 INITIAL AND CONTINUING CALIBRATIONS

All initial and continuing calibrations were acceptable.

2.3.4 METHOD AND FIELD BLANK ANALYSIS

The purpose of laboratory method blank and field equipment rinsate blank analysis is to evaluate the existence and magnitude of contamination resulting from laboratory and field activities. No discrepancies were noted.

2.3.5 SURROGATE SPIKE RECOVERY RESULTS

Laboratory performance on individual samples is established by fortifying each sample with surrogate compounds. Surrogate compounds included TCMX and DCB.

The surrogate spiking solution used in preparing batches B704037 and B704045 was 10 times lower than the amount listed in the SOP. Most of the low recovery responses were manually integrated to provide some level of quantification for the affected samples. With the exceptions noted in the next paragraph, the quantitative results were within QC limits. No qualifications are warranted.

Surrogate recoveries were within the acceptable limits, except for samples S36-OC-17, S37-OC-18, S41-OC-21A, S43-OC-23, S44-OC-24, and S45-OC-25, where the DCB surrogate recovery is above the upper control limit, and S34-OC-15, where the TCMX surrogate recovery is above the upper control limit. An acceptable recovery was reported for at least one of the two fortified surrogates; thus, no action was taken to qualify the sample data.

2.3.6 MS/MSD RECOVERY AND RPD RESULTS

Field samples S01-DC-01 and S34-OC-15 were used for the MS/MSD analysis. Project accuracy and precision objectives were met. No action was needed to qualify the sample result.

2.3.7 LCS RECOVERY RESULTS

Data for LCSs are generated to provide information on the accuracy of the analytical method and on the laboratory performance. Accuracy and precision objectives were acceptable for two of the four extraction batches. LCS and MS/MSD pairs were not extracted with samples from batch B704034 (aqueous samples 0704009-47 and 0704009-48) or batch B704042 (sediment samples 0704009-20 to 0704009-33). No qualifications are warranted for this data gap.

2.3.8 INTERNAL STANDARD AREA COUNTS AND RETENTION TIMES

ISs are not used with the PCB analysis.

2.3.9 FIELD DUPLICATE ANALYSIS

In accordance with the approved QAPP/FSP, field duplicates were not collected for the sediment samples.

2.3.10 LABORATORY DUPLICATE ANALYSIS

Laboratory duplicate sample are not required for the PCB analysis.

2.3.11 TARGET DETECTION LIMITS

Target detection limits were met for the analysis of PCBs for sediment samples. The low percent solids in some individual samples increased detection limits because sample results were adjusted for dry-weight concentrations. Despite this, almost all laboratory detection limits were still below the QAPP-specified reporting limits, so there are no serious effects on data usability.

2.3.12 TARGET COMPOUNDS IDENTIFICATION AND QUANTITATION

PCB measurements are confirmed on a second instrument column and detector operating under a different set of instrument conditions. The measurement must appear within established retention times on both sets of instrument conditions for a target compound to be reported. Quantitation (from the primary column) and identification (from primary and secondary columns) were performed correctly. As is frequently seen, the degraded PCB mixtures found in the samples were only fair matches to the mixtures in the calibration standards. A different analyst might make different identifications of the mixtures as Aroclors and therefore produce different quantitative results. Sediment results were corrected to dry weight.

3.0 INORGANICS DATA VALIDATION RESULTS

The results of the inorganic data validation are summarized below in terms of the QC parameters reviewed. The GLNPO data qualifiers below were applied to the sample analytical results where warranted.

- J – Estimated value; greater than detection limit but less than reporting limit
- B – Analyte detected in laboratory method blank
- H – Estimated value; holding time limit exceeded
- LD – Estimated value; batch quality control for laboratory duplicate exceeds upper or lower control limits
- U – Analyte not detected at or above reporting limit
- R – Result is rejected; analyte may or may not be present

3.1 TOTAL METALS

3.1.1 HOLDING TIMES

The holding time requirement for metal analysis of sediment samples is within 6 months after the sample is collected for both preparation and analysis. The holding time requirement for mercury is within 28 days for both preparation and analysis of sediment samples. Sample preservation and sample preparation were within method recommendations. Analysis holding times were achieved.

Initial sample weights for the mercury analysis varied from 0.1 to 0.35 grams. Standing water was present in some sample containers. Although the samples were homogenized, the correlation between solids content measurements and the actual solids content of the sub-sample aliquots may be imprecise.

Completed sample preparation logs were not included in the data packages. Only initial sample size is documented on the bench sheets for solid samples. No amounts are documented for the aqueous matrix. One reagent blank sample and a single LCS were prepared with the 46 field samples batch. In addition, the laboratory prepared five sets of MS/MSD samples. The same sample digestion was used for inductively coupled plasma (ICP), ICP-mass spectrometry (MS), and graphite furnace atomic absorption (GFAA) analysis. Types and amounts of digesting acid are not documented in the sample preparation reports. No qualifications were applied for this data gap.

3.1.2 INITIAL AND CONTINUING CALIBRATIONS

Initial and continuing calibration for analysis of metals was within established QC limits.

The ICP metals and CVAA mercury analytical sequence allowed more than 10 samples to be bracketed by continuing calibration standards and blanks. The laboratory included the blank as a data point in the initial calibration curve calculations. For mercury, four standards and a blank were used to calibrate the instruments. Curves were not presented in the data package, although the slope and intercept could be recalculated. The laboratory ran numerous initial calibrations (ICAL) before the data for arsenic and

selenium calibration curves were accepted, without explaining the basis for the decision. Possible reasons for rejecting initial calibrations include instrument instability (which would affect subsequent analyses) and deteriorated calibration standards (which would not affect samples analyzed after an acceptable calibration). Because the initial and continuing calibrations that were used for quantitating these samples were acceptable, no qualifications were applied for this discrepancy in the data package.

3.1.3 METHOD AND FIELD BLANK ANALYSIS

The purpose of laboratory method blank and field equipment rinsate blank analysis is to evaluate the existence and magnitude of contamination resulting from laboratory and field activities.

Trace levels of metals were present in at least one or more of the following blanks: initial calibration blank, continuing calibration blank, reagent blank, and equipment rinse blank. Action levels were established using the 5X rule. (That is, any sample with a concentration on the instrument less than five times the concentration of the highest associated blank is qualified.) Solid matrix action levels were applied to the following metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and zinc. Sample results less than the action levels are qualified as non-detected and were flagged “U, B.” Qualifications were required only for some mercury results.

3.1.4 INTERFERENCE CHECK SAMPLES (ICS)

The ICP-ICS verifies the contract laboratory’s interelement and background correction factors. The laboratory did not report interelement interference check audits. However, the project case narrative describes the audits as showing no interferences. No qualifications were applied for this data gap.

3.1.5 MS/MSD RECOVERY AND RPD RESULTS

Field samples S01-DC-01, S11-DC-11, S21-OC-02, S31-OC-12, and S41-OC-21A were used for the matrix spike analysis. The matrix accuracy objective was met so no qualifications were applied. Laboratory duplicates (discussed below) were used instead of MSD to assess precision.

3.1.6 LCS RECOVERY RESULTS

Data for LCS are generated to provide information on the accuracy of the analytical method and on the laboratory performance. All LCS recoveries were within QC limits.

3.1.7 LABORATORY DUPLICATE ANALYSIS

The purpose of duplicate sample analysis is to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate analyses are also used to generate data that evaluate the long-term precision of the analytical method. Laboratory duplicate data for metals were obtained from sediment samples S01-DC-01, S11-DC-11, S21-OC-02, S31-OC-12, and S41-OC-21A. The precision objectives were met so no qualifications were applied.

3.1.8 SERIAL DILUTION RESULTS

The serial dilution of samples quantitated by ICP evaluates whether significant physical or chemical interferences exist because of the sample matrix. The laboratory did not perform serial dilution analysis, which is required by some ICP methods but is optional for the methods used by the laboratory. No qualifications are warranted.

3.1.9 SAMPLE RESULT QUANTITATION

Results were quantitated correctly. Some samples were re-analyzed at one or more dilutions to bring all results within calibration range. Sediment concentrations for the ICP metals were reported on the EDD as wet weight. These results were corrected to dry weight in the “DV Value” column on the EDD.

3.1.10 OTHER ISSUES

The project QAPP requests only the eight Resource Conservation and Recovery Act (RCRA) metals, whereas the laboratory reports additional metals.

The laboratory reports that cadmium measurements by ICP-AES (EPA SW-846 Method 6010) appeared to be biased by a spectral interference. The ICP-MS data (acquired by EPA SW-846 Method 6020, which was not listed in the QAPP) are used in preference to the ICP data because this method produced lower detection and reporting limits and consequent higher quality analytical results. Therefore, the ICP cadmium data were flagged “R” to indicate that they should not be used and that the ICP-MS data should be used instead.

3.2 GENERAL CHEMISTRY FOR TOTAL ORGANIC CARBON, OIL AND GREASE, AND GRAIN SIZE ANALYSIS

3.2.1 HOLDING TIMES

The holding time requirement for O&G is within 28 days for both preparation and analysis of sediment samples. CRL’s standard operating procedure does not specify a holding time requirement for TOC. However, all samples were prepared within 24 days of collection and analyzed within 12 days of preparation. There are no holding time requirements for grain size analysis.

No deficiencies were noted for the analyses of O&G. The solid samples analyzed for TOC were analyzed after the National Exposure Research Laboratory-recommended holding time of 28 days. These data are qualified as an estimate and are flagged “H.”

3.2.2 INITIAL AND CONTINUING CALIBRATIONS

Initial and continuing calibration standard results for TOC and O&G were within QC limits. The only calibration for grain size analysis is that of the balances used to weigh the sample and the sieves. These data are routinely recorded in logs at each balance and were not copied into the laboratory report. No qualifications are warranted for these omissions.

3.2.3 METHOD AND FIELD BLANK ANALYSIS

The purpose of laboratory method blank and field equipment rinsate blank analysis is to evaluate the existence and magnitude of contamination resulting from laboratory and field activities.

Method blanks were absent for the O&G analyses and not used for the grain size analyses. Trace levels of TOC are reported in the method, instrument, and field blanks. No action was taken to qualify the sample results because the sample results were considerably higher.

3.2.4 INTERFERENCE CHECK SAMPLES (ICS)

The inductively coupled plasma-interference check sample is not used in the general chemistry analysis.

3.2.5 MS/MSD RECOVERY AND RPD RESULTS

Matrix spike samples were prepared using field sample S01-DC-01 (TOC and O&G) and S40-OC-21 (TOC), but are not used for grain size analysis. Because of software reporting errors, the laboratory originally reported the TOC data with zero percent recoveries. The laboratory reviewed the reporting error, and the re-generated reports indicate the correct values.

The results of the MS analyses (after re-generation of the reports) were within QC limits, so no qualifications were applied.

3.2.6 LCS RECOVERY RESULTS

Laboratory control samples were used for the analysis of O&G and TOC. Accuracy objectives were met, except that the LCS for the single aqueous batch of O&G samples slightly exceeds the upper control limit. No action was taken because the sample was an equipment rinsate blank and contained no O&G.

3.2.7 LABORATORY DUPLICATE ANALYSIS

Laboratory duplicate data for TOC were obtained from sediment samples 0704009-01 and 0704009-40.

Matrix duplicate samples were prepared using field sample S01-DC-01 (TOC and O&G) and S40-OC-21 (TOC). Acceptable project precision objectives were obtained for data on O&G. Unacceptable project precision objectives (43.6 and 43.1 RPD) were obtained for the analysis of TOC. All TOC sample results were reported as detected, and all sediment data are qualified as estimates and are flagged “LD.”

Laboratory duplicates for the grain size analysis were prepared from samples S01-DC-01 and S21-OC-02. Precision did not meet the laboratory’s QC limits, due to the small masses of sediment retained on each sieve and the consequent large relative errors in weighing the soil relative to the high tare weight of the sieve. No qualifications were applied for these inherent irregularities.

3.2.8 SERIAL DILUTION RESULTS

Serial dilutions are not used with the general chemistry analysis

3.2.9 SAMPLE RESULT QUANTITATION

Sample results were quantitated correctly. Most sediment results were corrected to dry weight. However, the laboratory reported TOC on the EDD as wet weight. These results were corrected to dry weight in the “DV Value” column of the EDD.

In the grain size analysis, five samples (those used for laboratory duplicate analysis and three more randomly selected ones) were verified. Quantitation was performed correctly, with only weighing and round-off errors in sample results. Data users should note that these errors are relatively large in some samples. The relative errors were especially large in samples with low solids content (such as the 17.3 percent in sample S12-DC-12). In these samples, small amounts of solids were sieved with high fractions passing through the smallest (No. 200) sieve (such as the greater than 95 percent for sample S10-DC-10).

As a result, one could be weighing 0.10 gram or less for a fraction caught on a sieve with a tare weight around 650 grams, making it difficult to obtain precise and accurate results.

4.0 DATA ASSESSMENT

The analytical results meet the data quality objectives defined by the applicable method and validation guidance documentation. The only data that were rejected were for benzo(g,h,i)perylene in some samples. Otherwise, the analytical data generated by CRL are acceptable for any use as qualified.

Data users should note that the inherent nature of some samples raised sample detection limits. Results were corrected to dry weight, with particularly high corrections for samples with low solids content. In addition, some sediment samples are mostly very small particles (passing a No. 200 sieve, less than 75 micrometers in effective diameter). Therefore, there are large relative errors in determining the proportions of the few larger particles in these samples. This must be considered when estimating the overall size distributions for the sediments.

ATTACHMENT
CONTRACT LABORATORY QA/QC ANALYSIS CHECKLISTS
FOR SEDIMENT CHEMISTRY ANALYSIS
(13 Pages)

Contract Lab QA/QC Analysis Checklist for SEDIMENT CHEMISTRY ANALYSIS

GRANT/IAG NUMBER: Not Applicable
PROJECT NAME: Duck and Otter Creeks Site, Sample Delivery Group 0704009
REVIEWER: Christopher Ohland
DATE: 08/29/07

1. What sediment chemistry data has been collected (CHECK ALL THAT APPLY)?

<input type="checkbox"/> Total Metals	<input type="checkbox"/> PCBs	<input type="checkbox"/> pH	<input type="checkbox"/> TOC
<input type="checkbox"/> Dioxins/Furans	<input checked="" type="checkbox"/> PAHs	<input type="checkbox"/> Pesticides	<input type="checkbox"/> DO
<input type="checkbox"/> SEM Metals	<input type="checkbox"/> Particle Size	<input type="checkbox"/> AVS	<input type="checkbox"/> Other

2. Were the target detection limits met for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

3. Were the Method Blanks less than the established MDL for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

4. Did the results of Field Duplicate Analysis vary by less than the % RPD specified in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

5. Did the results of the Field Replicates Analysis vary by less than the % RPD specified in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

6. Did the surrogate spike recoveries meet the limits set forth in the QAPP?

YES ☐
NO ☒ (UNACCEPTABLE)

7. Did the MS/MSD recoveries meet the limits set forth in the QAPP?

YES ☐
NO ☒ (UNACCEPTABLE)

8. Did the RPD (%) of the MS/MSD sample set meet the limits set forth in the QAPP?

YES
NO X (UNACCEPTABLE)

9. Did the initial calibration verification standards meet the requirements set forth in the QAPP?

YES
NO X (UNACCEPTABLE)

10. Did all required analysis take place within the required holding time protocols set forth in the QAPP?

YES
NO X (UNACCEPTABLE)

11. Did the laboratory duplicates vary by less than the % RPD specified in the QAPP?

YES NA
NO NA (UNACCEPTABLE)

12. Are measured dry weight contaminant concentrations reported? (Note: Conversion from wet weight to dry weight concentration may occur ONLY if data on moisture or TOC are provided. Nominal concentrations are unacceptable.)

YES X
NO (UNACCEPTABLE)

13. Please provide details for all of the "UNACCEPTABLE" marked above. Include details on the specific analytes affected by any QA/QC discrepancies, and recommendations regarding usability of data.

Item 6: All surrogate compounds were recovered within the expected control limits, except samples S11-DC-11 and S21-OC-02, where recovery for one of the three base/neutral surrogates was below the lower control limit. Deficiencies were also noted for samples S33-OC-14 and S42-OC-22, where recovery for one of the three base/neutral surrogates was above the upper control limit. No action was needed to qualify the data when one surrogate fails but the others are acceptable. The laboratory believes that the surrogate cocktail was not fortified in samples S23-OC-04, S25-OC-05, S25-OC-06, S25-OC-07, S25-OC-08, S25-OC-09, S25-OC-10, and S25-OC-11. These samples were re-extracted outside of the EPA-recommended holding time and reported as described previously.

Items 7 and 8: An MS/MSD pair was included with every extraction batch except the aqueous field QC samples. In all cases, native levels of PAHs were present that interfered with the concentration of the fortified PAHs. Higher concentrations in the fortified spike would have been more appropriate. With the exception of benzo(g,h,i)perylene, the lowest recovery was 24.7 percent and the highest recovery was within the established control limits. The MS and MSD data are similar to the laboratory control sample performance and do not provided a conclusive assessment that matrix accuracy or precision is compromised. No action was taken to qualify the data based on the MS/MSD results. The MS samples associated with batch 074046 and 074047 reported zero or low benzo(g,h,i)perylene recovery that was attributed to a malfunctioning gel permeation chromatography

(GPC) fractionation procedure. A subset of these samples was re-extracted as a result of surrogate deficiencies, but was not run through the GPC.

Results for benzo(g,h,i)perylene are qualified as rejected and flagged “R” and “M” in the following samples: S01-DC-01, S02-DC-02, S03-DC-03, S04-DC-04, S05-DC-05, S06-DC-06, S07-DC-07, S08-DC-08, S09-DC-09, S10-DC-10, S11-DC-11, S12-DC-12, S13-DC-13, S14-DC-14, S15-DC-15, S16-DC-16, S17-DC-17, S18-DC-18, S19-DC-19, S20-OC-01, S22-OC-03, S31-OC-12, S32-OC-13, and S33-OC-14. Results for benzo(g,h,i)perylene in samples originally in these extraction batches but later re-extracted are not qualified here, but are discussed elsewhere under holding time.

Item 9: Minor CCV QC deficiencies were observed for indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. Samples associated with the deficient calibrations were qualified as estimates and were flagged “J” if detected, and “UJ” if not detected. The following results were qualified “CV” or “U, CV”, as appropriate.

- Benzo(g,h,i)perylene: S12-DC-12, S13-DC-13, S14-DC-14, S15-DC-15, S16-DC-16, S17-DC-17, S18-DC-18, S19-DC-19, S20-OC-01, S21-OC-02, and S22-OC-03
- Indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene: S31-OC-12, S32-OC-13, and S33-OC-14
- Indeno(1,2,3-cd)pyrene and benzo(g,h,i)perylene: S29-OC-10 and S30-OC-11

Item 10: Sample holding times were met except for samples S23-OC-04, S24-OC-05, S25-OC-06, S26-OC-07, S27-OC-08, S28-OC-09, S29-OC-10, and S30-OC-11. The laboratory believes it omitted adding a surrogate solution to some of the samples assigned to batch 074047. The samples were re-extracted (holding time ranged from 55 to 57 days) outside of the EPA-recommended holding time of 14 days. Both data sets were reported. Most of the samples contained detectable amounts of PAHs; however, the accuracy and precision of the data set are unknown for the original sample extracts and are assumed to be biased low for the re-extraction because sample quality may have degraded in the re-extracted data set. The re-extracted sample set is preferred for use over the original data set because PAH degradation in a laboratory-refrigerated environment is expected to be minimal. The original dataset is qualified as rejected and flagged “R.” The re-extracted data set is qualified as an estimate and is flagged “H” or “U, H”, as appropriate. Samples S47-ER-EK-01 and S48-ER-SH-02 were analyzed (holding time 42 days) outside of the EPA-recommended holding time for extracts of 40 days. Target compounds were absent from these field rinsate samples, and the non-detected results are qualified as estimates and are flagged “U, H.”

Additional item: The laboratory control samples were used to assess the accuracy of the extraction batches associated with this sample delivery group, except batch 074050 (aqueous field QC samples). With the exception of benzo(g,h,i)perylene, the lowest recovery was 62.9 percent and the highest recovery was 110 percent. Performance of the laboratory control sample recoveries is similar to the MS/MSD pairs, although the overall recovery values are improved in the absence of native target compounds. The LCSs associated with batch 074046 and 074047 showed zero benzo(g,h,i)perylene recovery that was attributed to a malfunctioning GPC fractionation procedure. Low benzo(g,h,i)perylene recoveries were also observed with field sample batches 074048 and 070449. Samples assigned to batches 074050 and 075035 were not run through the GPC clean up process. Because of the widespread deficiency, benzo(g,h,i)perylene results for all field samples associated with batches 074046, 074047, 074048, and 074049 are qualified as rejected and flagged “R, LC.”

Items not applicable (NA): In accordance with the approved quality assurance project plan (QAPP) and field sampling plan (FSP), field duplicate and field replicate samples were not required for this project (Items 4 and 5). Laboratory duplicate samples were not analyzed, but the MS/MSD analysis discussed above serves as a laboratory duplicate analysis (Item 11).

Contract Lab QA/QC Analysis Checklist for SEDIMENT CHEMISTRY ANALYSIS

GRANT/IAG NUMBER: Not Applicable
PROJECT NAME: Duck and Otter Creeks Site, Sample Delivery Group 0704009
REVIEWER: Christopher Ohland
DATE: 08/29/07

1. What sediment chemistry data has been collected (CHECK ALL THAT APPLY)?

<input type="checkbox"/> Total Metals	<input type="checkbox"/> PCBs	<input type="checkbox"/> pH	<input type="checkbox"/> TOC
<input type="checkbox"/> Dioxins/Furans	<input type="checkbox"/> PAHs	<input checked="" type="checkbox"/> Pesticides	<input type="checkbox"/> DO
<input type="checkbox"/> SEM Metals	<input type="checkbox"/> Particle Size	<input type="checkbox"/> AVS	<input type="checkbox"/> Other

2. Were the target detection limits met for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

3. Were the Method Blanks less than the established MDL for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

4. Did the results of Field Duplicate Analysis vary by less than the % RPD specified in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

5. Did the results of the Field Replicates Analysis vary by less than the % RPD specified in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

6. Did the surrogate spike recoveries meet the limits set forth in the QAPP?

YES ☐
NO ☒ (UNACCEPTABLE)

7. Did the MS/MSD recoveries meet the limits set forth in the QAPP?

YES ☐
NO ☒ (UNACCEPTABLE)

8. Did the RPD (%) of the MS/MSD sample set meet the limits set forth in the QAPP?

YES
NO X (UNACCEPTABLE)

9. Did the initial calibration verification standards meet the requirements set forth in the QAPP?

YES
NO X (UNACCEPTABLE)

10. Did all required analysis take place within the required holding time protocols set forth in the QAPP?

YES
NO X (UNACCEPTABLE)

11. Did the laboratory duplicates vary by less than the % RPD specified in the QAPP?

YES NA
NO NA (UNACCEPTABLE)

12. Are measured dry weight contaminant concentrations reported? (Note: Conversion from wet weight to dry weight concentration may occur ONLY if data on moisture or TOC are provided. Nominal concentrations are unacceptable.)

YES X
NO (UNACCEPTABLE)

13. Please provide details for all of the "UNACCEPTABLE" marked above. Include details on the specific analytes affected by any QA/QC discrepancies, and recommendations regarding usability of data.

Item 6: The laboratory reported 19 instances where substantial co-elution interference prevented quantification of the DCB surrogate. For the following list of samples, TCMX surrogate recoveries were greater than the upper control limit and DCB could not be quantified because of the interferences. The data associated with these samples are qualified as estimated and are flagged "LS." The sample list includes S21-OC-02, S22-OC-03, S23-OC-04, S24-OC-05, S25-OC-06, S26-OC-07, S27-OC-08, S28-OC-09, S32-OC-13, and S39-OC-20.

Items 7 and 8: Field sample S20-OC-01 was used for the MS/MSD analysis. Project accuracy objectives were not met for 20 of the 38 fortified compounds, and precision objectives were not met for 14 of the 19 target compounds. Because of the widespread deficiency, all of the results associated with this sample are qualified as estimates and are flagged "M, MS" if detected, and "U, M, MS" if not detected. Two solid extraction batches did not include MS/MSD pairs as part of the laboratory QC audits. The laboratory justifies this action in its policy to alternately fortify extraction batches with organochlorine pesticides one time and PCBs the next, which was the case for this project.

Item 9: Initial and continuing calibrations and ongoing instrument performance were not acceptable for numerous reasons. Deficiencies in the initial and continuing calibrations were reported for primary and secondary columns including: signal 1 (delta-BHC; 4,4'-DDD; endosulfan II; endrin aldehyde; and endrin ketone) and signal 2 (heptachlor; 4,4'-DDT, and endrin ketone). It was not possible to readily identify the signal the laboratory used to quantify the organochlorine pesticide detections without additional information that was not provided in the data packages, so no qualifications were applied.

Item 10: All samples were originally extracted within holding times. Sample S11-DC-11 was re-extracted because the original extract was lost in the laboratory. The re-extraction occurred outside of the recommended holding time. The sample results are qualified as estimates and flagged "H" if detected, and "U, H" if non-detected.

Items not applicable (NA): In accordance with the approved quality assurance project plan (QAPP) and field sampling plan (FSP), field duplicate and field replicate samples were not required for this project (Items 4 and 5). Laboratory duplicate samples were not analyzed, but the MS/MSD analysis discussed above serves as a laboratory duplicate analysis (Item 11).

Contract Lab QA/QC Analysis Checklist for SEDIMENT CHEMISTRY ANALYSIS

GRANT/IAG NUMBER: Not Applicable
PROJECT NAME: Duck and Otter Creeks Site, Sample Delivery Group 0704009
REVIEWER: Christopher Ohland
DATE: 08/29/07

1. What sediment chemistry data has been collected (CHECK ALL THAT APPLY)?

<input type="checkbox"/> Total Metals	<input checked="" type="checkbox"/> PCBs	<input type="checkbox"/> pH	<input type="checkbox"/> TOC
<input type="checkbox"/> Dioxins/Furans	<input type="checkbox"/> PAHs	<input type="checkbox"/> Pesticides	<input type="checkbox"/> DO
<input type="checkbox"/> SEM Metals	<input type="checkbox"/> Particle Size	<input type="checkbox"/> AVS	<input type="checkbox"/> Other

2. Were the target detection limits met for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

3. Were the Method Blanks less than the established MDL for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

4. Did the results of Field Duplicate Analysis vary by less than the % RPD specified in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

5. Did the results of the Field Replicates Analysis vary by less than the % RPD specified in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

6. Did the surrogate spike recoveries meet the limits set forth in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

7. Did the MS/MSD recoveries meet the limits set forth in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

8. Did the RPD (%) of the MS/MSD sample set meet the limits set forth in the QAPP?

YES X
NO (UNACCEPTABLE)

9. Did the initial calibration verification standards meet the requirements set forth in the QAPP?

YES X
NO (UNACCEPTABLE)

10. Did all required analysis take place within the required holding time protocols set forth in the QAPP?

YES
NO X (UNACCEPTABLE)

11. Did the laboratory duplicates vary by less than the % RPD specified in the QAPP?

YES NA
NO NA (UNACCEPTABLE)

12. Are measured dry weight contaminant concentrations reported? (Note: Conversion from wet weight to dry weight concentration may occur ONLY if data on moisture or TOC are provided. Nominal concentrations are unacceptable.)

YES X
NO (UNACCEPTABLE)

13. Please provide details for all of the "UNACCEPTABLE" marked above. Include details on the specific analytes affected by any QA/QC discrepancies, and recommendations regarding usability of data.

Item 10: Sample S11-DC-11 was re-extracted because the original extract was lost in the laboratory. The re-extraction occurred outside of the recommended holding time. All non-detected results for this sample are qualified as estimates and are flagged "U, H."

Items not applicable (NA): In accordance with the approved quality assurance project plan (QAPP) and field sampling plan (FSP), field duplicate and field replicate samples were not required for this project (Items 4 and 5). Laboratory duplicate samples were not analyzed, but the MS/MSD analysis discussed above serves as a laboratory duplicate analysis (Item 11).

Contract Lab QA/QC Analysis Checklist for SEDIMENT CHEMISTRY ANALYSIS

GRANT/IAG NUMBER: Not Applicable
PROJECT NAME: Duck and Otter Creeks Site, Sample Delivery Group 0704009
REVIEWER: Christopher Ohland
DATE: 08/29/07

1. What sediment chemistry data has been collected (CHECK ALL THAT APPLY)?

<input checked="" type="checkbox"/> Total Metals	<input type="checkbox"/> PCBs	<input type="checkbox"/> pH	<input type="checkbox"/> TOC
<input type="checkbox"/> Dioxins/Furans	<input type="checkbox"/> PAHs	<input type="checkbox"/> Pesticides	<input type="checkbox"/> DO
<input type="checkbox"/> SEM Metals	<input type="checkbox"/> Particle Size	<input type="checkbox"/> AVS	<input type="checkbox"/> Other

2. Were the target detection limits met for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

3. Were the Method Blanks less than the established MDL for each parameter?

YES ☐
NO ☒ (UNACCEPTABLE)

4. Did the results of Field Duplicate Analysis vary by less than the % RPD specified in the QAPP?

YES ☐ NA
NO ☐ NA (UNACCEPTABLE)

5. Did the results of the Field Replicates Analysis vary by less than the % RPD specified in the QAPP?

YES ☐ NA
NO ☐ NA (UNACCEPTABLE)

6. Did the surrogate spike recoveries meet the limits set forth in the QAPP?

YES ☐ NA
NO ☐ NA (UNACCEPTABLE)

7. Did the MS/MSD recoveries meet the limits set forth in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

8. Did the RPD (%) of the MS/MSD sample set meet the limits set forth in the QAPP?

YES X
NO (UNACCEPTABLE)

9. Did the initial calibration verification standards meet the requirements set forth in the QAPP?

YES X
NO (UNACCEPTABLE)

10. Did all required analysis take place within the required holding time protocols set forth in the QAPP?

YES X
NO (UNACCEPTABLE)

11. Did the laboratory duplicates vary by less than the % RPD specified in the QAPP?

YES NA
NO NA (UNACCEPTABLE)

12. Are measured dry weight contaminant concentrations reported? (Note: Conversion from wet weight to dry weight concentration may occur ONLY if data on moisture or TOC are provided. Nominal concentrations are unacceptable.)

YES
NO X (UNACCEPTABLE)

13. Please provide details for all of the "UNACCEPTABLE" marked above. Include details on the specific analytes affected by any QA/QC discrepancies, and recommendations regarding usability of data.

Item 3: Trace levels of metals were present in at least one or more of the following blanks: initial calibration blank, continuing calibration blank, reagent blank, and equipment rinse blank. Action levels were established using the 5X rule. (That is, any sample with a concentration on the instrument less than five times the concentration of the highest associated blank is qualified.) Solid matrix action levels were applied to the following metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and zinc. Sample results less than the action levels are qualified as non-detected and were flagged "U, B." Qualifications were required only for some mercury results.

Item 12: Sediment concentrations for the ICP metals were reported on the EDD as wet weight. These results were corrected to dry weight in the "DV Value" column on the EDD.

Items not applicable (NA): In accordance with the approved quality assurance project plan (QAPP) and field sampling plan (FSP), field duplicate and field replicate samples were not required for this project (Items 4 and 5). Laboratory duplicate samples were not analyzed, but the MS/MSD analysis discussed above serves as a laboratory duplicate analysis (Item 11). In addition, surrogate spike recoveries are not applicable to metals analysis (Item 6).

Contract Lab QA/QC Analysis Checklist for SEDIMENT CHEMISTRY ANALYSIS

GRANT/IAG NUMBER: Not Applicable
PROJECT NAME: Duck and Otter Creeks Site, Sample Delivery Group 0704009
REVIEWER: Christopher Ohland
DATE: 08/29/07

1. What sediment chemistry data has been collected (CHECK ALL THAT APPLY)?

<input checked="" type="checkbox"/> Total Metals	<input type="checkbox"/> PCBs	<input type="checkbox"/> pH	<input checked="" type="checkbox"/> TOC
<input type="checkbox"/> Dioxins/Furans	<input type="checkbox"/> PAHs	<input type="checkbox"/> Pesticides	<input type="checkbox"/> DO
<input type="checkbox"/> SEM Metals	<input type="checkbox"/> Particle Size	<input type="checkbox"/> AVS	<input checked="" type="checkbox"/> Other (O&G, grain size)

2. Were the target detection limits met for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

3. Were the Method Blanks less than the established MDL for each parameter?

YES ☒
NO ☐ (UNACCEPTABLE)

4. Did the results of Field Duplicate Analysis vary by less than the % RPD specified in the QAPP?

YES ☐ NA
NO ☐ NA (UNACCEPTABLE)

5. Did the results of the Field Replicates Analysis vary by less than the % RPD specified in the QAPP?

YES ☐ NA
NO ☐ NA (UNACCEPTABLE)

6. Did the surrogate spike recoveries meet the limits set forth in the QAPP?

YES ☐ NA
NO ☐ NA (UNACCEPTABLE)

7. Did the MS/MSD recoveries meet the limits set forth in the QAPP?

YES ☒
NO ☐ (UNACCEPTABLE)

8. Did the RPD (%) of the MS/MSD sample set meet the limits set forth in the QAPP?

YES X
NO (UNACCEPTABLE)

9. Did the initial calibration verification standards meet the requirements set forth in the QAPP?

YES X
NO (UNACCEPTABLE)

10. Did all required analysis take place within the required holding time protocols set forth in the QAPP?

YES
NO X (UNACCEPTABLE)

11. Did the laboratory duplicates vary by less than the % RPD specified in the QAPP?

YES X
NO (UNACCEPTABLE)

12. Are measured dry weight contaminant concentrations reported? (Note: Conversion from wet weight to dry weight concentration may occur ONLY if data on moisture or TOC are provided. Nominal concentrations are unacceptable.)

YES
NO X (UNACCEPTABLE)

13. Please provide details for all of the "UNACCEPTABLE" marked above. Include details on the specific analytes affected by any QA/QC discrepancies, and recommendations regarding usability of data.

Item 10: The solid samples analyzed for TOC were analyzed after the National Exposure Research Laboratory-recommended holding time of 28 days. These data are qualified as an estimate and are flagged "H."

Item 11: Matrix duplicate samples were prepared using field sample S01-DC-01 (TOC and O&G) and S40-OC-21 (TOC). Acceptable project precision objectives were obtained for data on O&G. Unacceptable project precision objectives (43.6 and 43.1 RPD) were obtained for the analysis of TOC. All TOC sample results were reported as detected, and all sediment data are qualified as estimates and are flagged "LD."

Item 12: The laboratory reported TOC on the EDD as wet weight. These results were corrected to dry weight in the "DV Value" column of the EDD.

Additional item: In the grain size analysis, five samples (those used for laboratory duplicate analysis and three more randomly selected ones) were verified. Quantitation was performed correctly, with

only weighing and round-off errors in sample results. Data users should note that these errors are relatively large in some samples. The relative errors were especially large in samples with low solids content (such as the 17.3 percent in sample S12-DC-12). In these samples, small amounts of solids were sieved with high fractions passing through the smallest (No. 200) sieve (such as the greater than 95 percent for sample S10-DC-10). As a result, one could be weighing 0.10 gram or less for a fraction caught on a sieve with a tare weight around 650 grams, making it difficult to obtain precise and accurate results.

Items not applicable (NA): In accordance with the approved quality assurance project plan (QAPP) and field sampling plan (FSP), field duplicate and field replicate samples were not required for this project (Items 4 and 5). Laboratory duplicate samples were not analyzed, but the MS/MSD analysis discussed above serves as a laboratory duplicate analysis (Item 11). In addition, surrogate spike recoveries are not applicable to these analyses (Item 6).

APPENDIX D
DUCK AND OTTER CREEKS
SEDIMENT TOXICITY TESTING

**TETRATECH, EMI
SulTRAC**

**DUCK AND OTTER CREEKS
SEDIMENT TOXICITY TESTING**

Presented by:

**American Aquatic Testing, Inc.
890 North Graham Street
Allentown, Pennsylvania 18109**

Contents

<u>Section</u>	<u>Page</u>
Introduction	1
Materials and Methods	1
Results	5
<u>Tables</u>	
I. Summary of Conditions for <i>Chironomus tentans</i> Toxicity Test	4
II: Percent survival of <i>C. tentans</i> by replicate chamber and location exposure area OC-A	5
III: Percent survival of <i>C. tentans</i> by replicate chamber and location exposure area OC-B	5
IV: Percent survival of <i>C. tentans</i> by replicate chamber and location exposure area OC-C	6
V: Percent survival of <i>C. tentans</i> by replicate chamber and location exposure area OC-D	6
VI: Percent survival of <i>C. tentans</i> by replicate chamber and location exposure area OC-E	6
VII: Percent survival of <i>C. tentans</i> by replicate chamber and location exposure area DC-A	7
VIII: Percent survival of <i>C. tentans</i> by replicate chamber and location exposure area DC-B	7
IX: Percent survival of <i>C. tentans</i> by replicate chamber and location exposure area DC-C	7
X: Percent survival of <i>C. tentans</i> by replicate chamber and location exposure area DC-D	8
XI: Percent survival of <i>C. tentans</i> by replicate chamber and location exposure area DC-E	8
XII: Mean dry weight of <i>C. tentans</i> by replicate chamber and location exposure area OC-A	8
XIII: Mean dry weight of <i>C. tentans</i> by replicate chamber and location exposure area DC-A	9
XIV: Mean dry weight of <i>C. tentans</i> by replicate chamber and location exposure area DC-C	9
XV: Mean dry weight of <i>C. tentans</i> by replicate chamber and location exposure area DC-D	9
XVI: Mean dry weight of <i>C. tentans</i> by replicate chamber and location exposure area DC-E	10

Appendices

- A. Raw data for *Chironomus tentans* 20-day survival and growth test
- B. Statistical analysis of *Chironomus tentans* 20-day survival and growth test
- C. Chain of Custody Documentation

DUCK AND OTTER CREEKS SEDIMENT TOXICITY TESTING

INTRODUCTION

During the month of April 2007, 16 sediment samples were collected from the Duck and Otter Creeks in the Maumee River Area of Concern (MAOC) near Toledo, Ohio. Those sediment samples were used to perform toxicity testing to determine whether the tested matrices represent a significant threat to potential receptor organisms that may inhabit the sediments in that portion of the MAOC.

The Duck and Otter Creek sediment samples were evaluated for toxicity using a 20-day solid phase exposure test, using the freshwater invertebrate *Chironomus tentans* (midge)^[1]. At the end of the exposure period, surviving test organisms from the sediment samples were collected, enumerated and weighed. The Duck and Otter Creek sediment sample results were compared to a control test set, all tests being performed under similar conditions. The endpoints used for determination of potential threat were mortality, measured as mean survival and growth, measured as mean dry weight.

MATERIALS AND METHODS

Sediment grab samples were collected from previously chosen sampling locations in portions of Duck and Otter Creeks where other assessments have been conducted in the past. All sample locations were selected across areas which have been previously identified with impacted sediments.

Preparation of sediment samples for testing

The sediment samples were collected on April 2, 3 and 4, 2007, placed in two-gallon HDPE containers, which were maintained on ice and transported to American Aquatic Testing, Inc.'s (AAT) Allentown, Pennsylvania laboratory on ice. The samples were sieved by AAT personnel using a 1000 µm mesh sieve to remove large debris and indigenous species that could have either competed with or potentially preyed upon the test organisms. The sieved portion of the sediment sample was then transferred to new, clean 1-gallon HDPE containers, sealed and stored at 0-4° C until used for setting up the testing on April 18, 2007.

The control sediment that was used for the test was collected from the Spruce Run Reservoir in Clinton, New Jersey on April 12, 2007, was sieved on April 13, 2007 and stored in the same manner as the Duck and Otter Creek sediment samples.

Test organisms

Test organisms (*Chironomus tentans*) were obtained from stock cultures maintained by Aquatic Biosystems, Inc. of Fort Collins, CO on April 17, 2007. During the short holding period prior to test initiation, the organisms were held under conditions similar to those that they would encounter during the test (see Table I), to acclimate them. At the beginning of the 20-day test exposure the test organisms were <1 day old.

A reference toxicant test using potassium chloride as the toxicant was performed concurrently with the 20-day exposure to evaluate the sensitivity of the lot of organisms used in the sediment test. The test conducted by AAT produced a 48 hr LC_{50} of 2618.3 ppm that falls within the acceptable range of the AAT internal control chart. The mean of the reference toxicant chart is 3207.4 ppm with confidence limits from 181.8 to 6232.9 ppm.

Experimental procedures

The entire sediment exposure series for this project consisted of 16 sediment samples collected from Duck and Otter Creeks and one control sediment sample from Spruce Run Reservoir. Test chambers (300 mL tall form borosilicate glass beakers) were filled with 100 mL of sediment. The sediment in each chamber was then covered with 175 mL of test water, EPA moderately hard water, with calcium hardness of 80-100 mg/L. Each sample exposure and control exposure consisted of five replicate chambers. All of the test chambers, following setup, were allowed to settle for 24 hours prior to test initiation.

After the settling period, the overlying water was siphoned off and fresh test water was introduced, using a small, round HDPE disk suspended over the sediment to deflect the water flow and minimize disturbance to the sediment. At the time the test was initiated alkalinity, ammonia, conductivity, dissolved oxygen, hardness, pH and temperature were measured for the overlying water for each test sample and the control.

The exposure period began when 12 randomly selected test organisms were introduced into each test chamber. Care was taken when the organisms were introduced into the test chambers to ensure that the organisms were released beneath the surface of the overlying water to keep air bubbles from forcing the organisms to the surface. Each test chamber was then fed 4.0 mg of fish flake food. Test conditions are summarized in Table I.

Each day during the exposure period observations were carried out on each chamber to determine the number of organisms that were either dead, swimming, on the surface of the sediment or on the surface of the water. Dissolved oxygen, pH and temperature were also measured daily. The overlying water was siphoned off twice a day and replaced as a measure for maintaining sufficient dissolved oxygen levels and prevent anoxic conditions from affecting the test results. Care was taken to minimize disturbance of the sediment during water renewal.

At the end of the 20-day exposure the final alkalinity, ammonia, conductivity, dissolved oxygen, hardness, pH and temperature were measured, and the test chambers were prepared for the removal of test organisms. Each chamber was gently stirred using a pipette to suspend the sediment in the overlying water. This slurry was then poured into a #60 mesh sieve (250 μ m) and gently rinsed in a shallow pan of laboratory water to remove the finer grains of the sediment and retain the test organisms. The remaining contents of the sieve were then placed into a second shallow pan of laboratory water, placed over a light table, and carefully sorted to find the surviving test organisms in each of the five replicates for each site Duck and Otter Creek sediment sample. All surviving organisms from each chamber were then transferred to a 30 mL soufflé cup for live count verification and preparation for weight analysis.

When all test chambers had been sorted and the number of survivors verified, 0.5 mL of ethanol was added to each soufflé cup to dispatch the organisms. They were then transferred to a previously dried and tared aluminum pan and placed into an oven to dry at 105° C for a minimum of six hours. Upon removal from the oven, the pans were placed into a desiccator to cool and then were weighed to the nearest 0.01 mg.

Data analysis

Data analysis was performed following procedures published by the USEPA^[1] using ToxCalc™ v5.0.23F data analysis software. Survival data were arcsine squareroot transformed, tested for normality using the Kolmogorov D Test, and tested for homogeneity of variances using Bartlett's test. Normally distributed data were analyzed using Analysis of Variance (ANOVA) followed by Dunnett's pairwise comparison of test means, or Bonferroni t Test. Non-normal data or those data sets exhibiting heterogeneity of variances were analyzed using Steel's Many-one Rank test or Wilcoxon Rank Sum, or other analysis as appropriate.

All raw data sheets are located in Appendix A.

TABLE I: Summary of Conditions for *Chironomus tentans* Toxicity Test

1.	Test type;	Whole sediment, static, daily renewal
2.	Temperature;	23.0 +/- 1.0° C
3.	Light quality;	Wide-spectrum fluorescent illumination
4.	Light intensity;	50 - 100 foot-candles
5.	Photoperiod;	16 hours light, 08 hours dark
6.	Test chamber size;	300 mL high form borosilicate glass beakers
7.	Sediment volume;	100 mL / replicate
8.	Overlying water volume;	175 mL
9.	Renewal;	2 volume exchanges per day
10.	Age of test organisms;	< 1 day
11.	Number organisms / container;	12
12.	Replicates;	5
13.	Feeding;	4.0 mg flake fish food / day
14.	Aeration;	None unless dissolved oxygen concentrations were \leq 40 % saturation, then ~ 100 bubbles / min.
15.	Overlying water;	Laboratory Reconstituted Moderately Hard Water
16.	Test chamber cleaning;	Only if necessary
17.	Overlying water quality;	D. O., pH and temperature daily; alkalinity, ammonia, conductivity and hardness at beginning and end of test
18.	Test duration;	20 days
19.	Endpoints;	Percent survival and growth (mean dry weight)
20.	Test acceptability;	Minimum control survival 70 %, average control dry weight 0.6 mg

RESULTS

Effects on Survival – Duck and Otter Creek Sediment Samples

For the first of the two endpoints used, survival, the data from all sample locations are analyzed in groups which correspond to TABLE 7: DUCK AND OTTER CREEK SAMPLING LOCATIONS BY EXPOSURE AREA taken from the QUALITY ASSURANCE PROJECT PLAN AND FIELD SAMPLING PLAN DUCK AND OTTER CREEKS TOLEDO AND OREGON, OHIO (QAPP). All samples are compared to the laboratory control, which exceeded the required minimum of 70% survival.

Of the nine sediment samples from Otter Creek, only OC-01 exhibited survival not found to be different from the control. All other locations were significantly different from the control sample. Tables II through VI summarize results for Otter Creek Exposure Areas OC-A through OC-E, respectively.

Table II: Percent survival of *C. tentans* by replicate chamber and location exposure area OC-A

Rep	CONTROL	OC-01	OC-03*	OC-05*	OC-07*
A	91.7	41.7	58.3	41.7	41.7
B	83.3	91.7	0	0	0
C	100	75	58.3	0	25
D	83.3	75	83.3	33.3	25
E	100	16.7	41.7	8.3	33.3
Mean Survival	91.7	60	48.3	16.7	16.7
Statistically different from Control?		NO	YES	YES	YES

* No growth analysis performed

Table III: Percent survival of *C. tentans* by replicate chamber and location exposure area OC-B

Rep	CONTROL	OC-07*	OC-11*
A	91.7	41.7	50
B	83.3	0	58.3
C	100	25	50
D	83.3	25	33.3
E	100	33.3	25
Mean Survival	91.7	16.7	43.3
Statistically different from Control?		YES	YES

* No growth analysis performed

Table IV: Percent survival of *C. tentans* by replicate chamber and location exposure area OC-C

Rep	CONTROL	OC-11*	OC-14*
A	91.7	50	58.3
B	83.3	58.3	100
C	100	50	33.3
D	83.3	33.3	33.3
E	100	25	33.3
Mean Survival	91.7	43.3	51.7
Statistically different from Control?		YES	YES

* No growth analysis performed

Table V: Percent survival of *C. tentans* by replicate chamber and location exposure area OC-D

Rep	CONTROL	OC-19*	OC-22*
A	91.7	58.3	58.3
B	83.3	66.7	58.3
C	100	33.3	0
D	83.3	50	8.3
E	100	58.3	25
Mean Survival	91.7	53.3	30
Statistically different from Control?		YES	YES

* No growth analysis performed

Table VI: Percent survival of *C. tentans* by replicate chamber and location exposure area OC-E

Rep	CONTROL	OC-22*	OC-26*
A	91.7	58.3	41.7
B	83.3	58.3	0
C	100	0	58.3
D	83.3	8.3	25
E	100	25	50
Mean Survival	91.7	30	35
Statistically different from Control?		YES	YES

* No growth analysis performed

Of the seven sediment samples from Duck Creek, sites DC-01, DC-05 and DC-08 exhibited survival that was found to be statistically different from the control sample. The remaining sites; DC-03, DC-010, DC-13 and DC-14 were not found to be different from the control. All other locations were significantly different from the control sample. Tables VII through XI summarize results for Duck Creek Exposure Areas DC-A through DC-E, respectively.

Table VII: Percent survival of *C. tentans* by replicate chamber and location exposure area DC-A

Rep	CONTROL	DC-01*	DC-03	DC-05*
A	91.7	0	100	8.3
B	83.3	50	83.3	25
C	100	58.3	83.3	66.7
D	83.3	66.7	91.7	66.7
E	100	41.7	66.7	33.3
Mean Survival	91.7	43.3	85	40
Statistically different from Control?		YES	NO	YES

* No growth analysis performed

Table VIII: Percent survival of *C. tentans* by replicate chamber and location exposure area DC-B

Rep	CONTROL	DC-05*	DC-08*
A	91.7	8.3	75
B	83.3	25	66.7
C	100	66.7	0
D	83.3	66.7	83.3
E	100	33.3	0
Mean Survival	91.7	40	45
Statistically different from Control?		YES	YES

* No growth analysis performed

Table IX: Percent survival of *C. tentans* by replicate chamber and location exposure area DC-C

Rep	CONTROL	DC-08*	DC-10
A	91.7	75	75
B	83.3	66.7	66.7
C	100	0	100
D	83.3	83.3	100
E	100	0	100
Mean Survival	91.7	45	88.3
Statistically different from Control?		YES	NO

* No growth analysis performed

Table X: Percent survival of *C. tentans* by replicate chamber and location exposure area DC-D

Rep	CONTROL	DC-10	DC-13
A	91.7	75	66.7
B	83.3	66.7	83.3
C	100	100	100
D	83.3	100	100
E	100	100	100
Mean Survival	91.7	88.3	90
Statistically different from Control?		NO	NO

Table XI: Percent survival of *C. tentans* by replicate chamber and location exposure area DC-E

Rep	CONTROL	DC-13	DC-14
A	91.7	66.7	75
B	83.3	83.3	83.3
C	100	100	91.7
D	83.3	100	100
E	100	100	83.3
Mean Survival	91.7	90	86.7
Statistically different from Control?		NO	NO

All statistical analyses are provided in Appendix B.

Effects on Growth – Duck and Otter Creek Sediment Samples

For the second of the two endpoints used, growth, measured as mean dry weight, the data from all sample locations are analyzed in groups which correspond to TABLE 7: DUCK AND OTTER CREEK SAMPLING LOCATIONS BY EXPOSURE AREA taken from the QUALITY ASSURANCE PROJECT PLAN AND FIELD SAMPLING PLAN DUCK AND OTTER CREEKS TOLEDO AND OREGON, OHIO (QAPP). All samples are compared to the laboratory control, which exceeded the recommended minimum of 0.6 mg per individual.

Of the nine sediment samples from Otter Creek, only OC-01 exhibited growth not found to be different from the control. All other locations were not analyzed for growth as they had significant reduction in survival. Table XII summarizes the result for Otter Creek Exposure Area OC-A.

Table XII: Mean dry weight in mg. of *C. tentans* by replicate chamber and location exposure area OC-A

Rep	CONTROL	OC-01
A	1.2682	2.5940
B	1.4520	1.3055
C	1.0158	1.8178
D	1.6320	1.1944
E	1.2842	4.980
Mean Dry Weight	1.3304	2.3783
Statistically different from Control?		NO

Of the seven sediment samples from Duck Otter Creek, several were found to not be significantly different from the control based on survival and were analyzed for growth. In Exposure Area DC-A, sample DC-03 had growth that exceeded that for the control. In Exposure Area DC-C sample DC-10 also exhibited growth greater than the control sample. For Exposure Areas DC-D and DC-E, all samples surpassed the control sample for growth. Tables XIII through XVI summarize the results for Duck Creek Exposure Area DC-A, DC-C, DC-D and DC-E, respectively.

All statistical analyses are provided in Appendix B.

Table XIII: Mean dry weight in mg. of *C. tentans* by replicate chamber and location exposure area DC-A

Rep	CONTROL	DC-03
A	1.2682	1.5092
B	1.4520	1.5200
C	1.0158	1.3780
D	1.6320	1.3564
E	1.2842	1.7813
Mean Dry Weight	1.3304	1.5090
Statistically different from Control?		NO

Table XIV: Mean dry weight in mg. of *C. tentans* by replicate chamber and location exposure area DC-C

Rep	CONTROL	DC-10
A	1.2682	1.6778
B	1.4520	2.2550
C	1.0158	1.3108
D	1.6320	1.2783
E	1.2842	1.2333
Mean Dry Weight	1.3304	1.5511
Statistically different from Control?		NO

Table XV: Mean dry weight in mg. of *C. tentans* by replicate chamber and location exposure area DC-D

Rep	CONTROL	DC-10	DC-13
A	1.2682	1.6778	1.1600
B	1.4520	2.2550	1.3950
C	1.0158	1.3108	1.3158
D	1.6320	1.2783	1.3108
E	1.2842	1.2333	1.4983
Mean Dry Weight	1.3304	1.5511	1.3360
Statistically different from Control?		NO	NO

Table XVI: Mean dry weight in mg. of *C. tentans* by replicate chamber and location exposure area DC-E

Rep	CONTROL	DC-14
A	1.2682	1.7167
B	1.4520	1.3870
C	1.0158	1.4782
D	1.6320	1.1950
E	1.2842	1.5930
Mean Dry Weight	1.3304	1.474
Statistically different from Control?	NO	

REFERENCES

- [1] Ingersoll, C.G. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates Second Edition EPA 600/R-99/064, MARCH 2000

APPENDIX A

RAW DATA FOR *Chironomus tentans* 20 DAY

SURVIVAL AND GROWTH TEST

Client/Toxicant: 140
 Project Number: 04-01
 Species: P. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310
 Hatch Date: Deposited 4/15-16/07

Sediment Test
 American Aquatic Testing, Inc.
 Observations / Live Count

Conc.	Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	
											Observ.	Final Live Count
Control	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
OC-01	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
OC-03	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
OC-05	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
OC-07	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
Initials		TAP	MKP	MKP	MKP	TAP	TAP	TAP	MKP	MKP	CP	
Date		4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	04/28	

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

Client/Toxicant: 140
 Project Number: 04-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310
 Hatch Date: Deposited 4/15-16/07

Sediment Test
 American Aquatic Testing, Inc.
 Observations / Live Count

Conc.	Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	
											Observ.	Final Live Count
Control	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
OC-11	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
OC-14	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
OC-19	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
OC-22	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
OC-26	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
Initials		TPP	WPP	MWP	MWP	TPP	TPP	TPP	WPP	MWP	9/	
Date		4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	04/28	

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

Client/Toxicant: 140
 Project Number: 04-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310
 Hatch Date: Deposited 4/15-16/07

Sediment Test
 American Aquatic Testing, Inc.
 Observations / Live Count

Conc.	Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	
											Observ.	Final Live Count
Control	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
DC-01	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
DC-03	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
DC-05	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
DC-08	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
DC-10	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
Initials		TP	MP	MPD	MPD	TP	TP	TP	MP	MP	MP	
Date		4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

Client/Toxicant: 140
 Project Number: 04-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310
 Hatch Date: Deposited 4/15-16/07

Sediment Test
 American Aquatic Testing, Inc.
 Observations / Live Count

Conc.	Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	
											Observ.	Final Live Count
DC-13	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
DC-14	A	N	N	N	N	N	N	N	N	N	N	
	B	N	N	N	N	N	N	N	N	N	N	
	C	N	N	N	N	N	N	N	N	N	N	
	D	N	N	N	N	N	N	N	N	N	N	
	E	N	N	N	N	N	N	N	N	N	N	
	F											
	G											
	H											
	A											
	B											
	C											
	D											
	E											
	F											
	G											
	H											
	A											
	B											
	C											
	D											
	E											
	F											
	G											
	H											
	A											
	B											
	C											
	D											
	E											
	F											
	G											
	H											
Initials		TAP	WRP	MAD	AKA	TAP	TAP	TAP	WRP	WRP	WRP	
Date		4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

Client/Toxicant: 140
 Project Number: 04-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1810
 Hatch Date: Deposited 4/15-16/07

Sediment Test
 American Aquatic Testing, Inc.
 Observations / Live Count

Conc.	Rep	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	
											Observ.	Final Live Count
Control	A	N	N	N	N	N	1F	N	1F	1F	N	11
	B	N	N	N	N	N	2F	N	1F	2F	N	10
	C	N	N	1F	1F	N	N	N	2F	N	N	12
	D	1F	1F	N	N	N	N	N	1F	3F	N	10
	E	N	N	N	N	N	1F	1F	2F	1M	N	12
	F											
	G											
	H											
OC-01	A	N	N	1F	N	N	N	N	N	N	N	5
	B	N	N	1F	1F	1F	2F	N	2F	2F	2F	11
	C	N	N	N	1F	1F	N	1F	1F	2F	1F	9
	D	N	1F	1F	N	1F	N	N	2F	N	N	9
	E	N	N	N	N	N	N	N	N	1F	N	2
	F											
	G											
	H											
OC-03	A	N	1F	N	N	N	N	N	N	N	N	7
	B	N	N	N	N	N	N	N	N	N	N	0
	C	N	N	N	N	N	N	N	1F	N	N	7
	D	N	N	N	N	N	1F	N	2F	N	N	10
	E	N	N	N	N	N	N	N	N	N	N	5
	F											
	G											
	H											
OC-05	A	1F	N	N	N	N	N	N	N	N	N	5
	B	N	N	N	N	N	N	N	N	N	N	0
	C	1F	N	N	N	N	N	N	N	N	N	0
	D	N	N	N	N	N	N	N	N	N	N	4
	E	N	N	N	N	N	N	N	N	N	N	1
	F											
	G											
	H											
OC-07	A	N	N	1F	1F	N	N	N	N	2F	N	5
	B	1F	N	N	N	N	N	N	N	N	N	0
	C	N	N	N	N	N	N	N	N	N	N	3
	D	N	N	N	N	N	N	N	N	N	N	3
	E	N	N	N	N	N	N	N	N	N	N	4
	F											
	G											
	H											
Initials		<u>GA</u>	<u>TD</u>	<u>TD</u>	<u>WV</u>	<u>MD</u>	<u>TD</u>	<u>TD</u>	<u>TD</u>	<u>TD</u>	<u>TD</u>	<u>TD</u>
Date		<u>6/1/09</u>	<u>4/30</u>	<u>5/1</u>	<u>5/2</u>	<u>5/3</u>	<u>5/4</u>	<u>5/5</u>	<u>5/6</u>	<u>5/7</u>	<u>5/8</u>	<u>5/8</u>

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

Client/Toxicant: 140
 Project Number: 04-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310
 Hatch Date: Deposited 4/15-16/07

Sediment Test
 American Aquatic Testing, Inc.
 Observations / Live Count

Conc.	Rep	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	
											Observ.	Final Live Count
Control OC-41	A	N	N	N	N	W	N	N	N	N	1F	6
	B	N	N	N	N	N	N	N	N	N	1F	7
	C	N	N	N	N	N	N	N	N	N	N	6
	D	1F	N	1F	N	N	N	N	N	1F	N	4
	E	N	N	N	N	N	N	N	N	N	N	3
	F											
	G											
	H											
OC-14	A	N	N	N	N	N	3F	N	N	N	N	7
	B	N	N	N	1F	N	3F	1F	N	N	N	12
	C	N	N	N	N	N	N	N	N	N	N	4
	D	N	N	N	N	N	N	N	N	N	N	4
	E	N	N	N	1F	N	1F	N	N	N	N	4
	F											
	G											
	H											
OC-19	A	N	N	N	N	N	1F	N	N	N	N	7
	B	N	N	N	N	N	1F	N	2F	3F	N	8
	C	N	N	N	N	N	N	N	N	N	N	4
	D	N	N	N	N	N	N	N	N	1F	2F	6
	E	N	N	N	N	N	2F	N	2F	N	N	7
	F											
	G											
	H											
OC-22	A	1F	N	N	N	N	N	N	N	N	N	7
	B	N	N	N	N	N	N	N	N	N	N	7
	C	N	N	N	N	N	N	N	N	N	N	0
	D	N	N	N	N	N	N	N	N	N	N	1
	E	N	N	N	N	N	N	N	N	N	N	3
	F											
	G											
	H											
OC-26	A	1F	N	N	N	N	1F	N	N	2F	2F	5
	B	N	N	N	N	N	N	N	N	N	N	0
	C	N	N	1F	N	N	3F	N	N	2F	2F	7
	D	N	N	N	N	N	N	N	N	N	N	3
	E	N	N	N	N	N	N	N	1F	N	1F	6
	F											
	G											
	H											
Initials		CP	TOP	TRP	WDR	MWP	TRP	TRP	TRP	TRP	TRP	TRP
Date		5/1/07	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/8

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

Client/Toxicant: 140
 Project Number: 04-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1810
 Hatch Date: Deposited 4/15-16/07

Sediment Test
 American Aquatic Testing, Inc.
 Observations / Live Count

American Aquatic Testing, Inc.												Day 20	
Observations / Live Count												Observ.	Final Live Count
Conc.	Rep	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18	Day 19			
Control	A	N	N	N	N	N	N	N	N	N	N	0	
	B	N	N	N	N	3F	2F	N	N	N	N	6	
	C	N	N	N	2F	3F	3F	N	N	N	N	7	
	D	N	1F	N	N	N	N	N	N	3F	N	8	
	E	N	N	N	N	N	N	N	N	N	N	5	
	F												
DC-01	G												
	H												
	A	N	N	N	1F	N	N	N	N	N	N	12	
	B	N	N	N	1F	N	N	N	N	N	N	10	
	C	1F	1F	N	N	N	1F	N	N	1F	N	10	
	D	N	N	N	N	N	N	N	N	1F	N	11	
DC-03	E	N	N	N	N	N	1F	N	N	N	N	8	
	F												
	G												
	H												
	A	N	N	N	N	N	N	N	N	N	N	1	
	B	N	N	N	N	N	N	N	N	N	N	3	
DC-05	C	N	N	N	N	N	N	N	1F	N	1F	8	
	D	N	N	N	N	N	1F	N	N	N	1F	8	
	E	N	N	N	N	N	N	N	1F	N	N	4	
	F												
	G												
	H												
DC-08	A	N	1F	N	N	N	2F	N	N	N	N	9	
	B	N	N	N	1F	1F	4F	N	N	1F	N	8	
	C	1F	N	N	N	N	N	N	N	N	N	0	
	D	N	N	N	N	1F	2F	N	N	N	N	10	
	E	N	N	N	N	N	N	N	N	N	N	0	
	F												
DC-08	G												
	H												
	A	N	1F	N	2F	N	2F	N	2F	N	N	9	
	B	N	1F	2F	1F	N	1F	1F	2F	2F	N	8	
	C	N	1F	N	N	N	1F	N	1F	1F	N	12	
	D	N	N	N	N	N	1F	N	2F	3F	1F	12	
DC-10	E	N	1F	N	1F	N	1F	1F	2F	1F	N	12	
	F												
	G												
	H												
	Intals	OK	TAP	TAP	VOW	MKD	TAP	TAP	TAP	TAP	TAP	TAP	
	Date	6/1/24	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/8	

Client/Toxicant: 140
 Project Number: 04-01
 Species: O. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07-1316
 Hatch Date: Deposited 4/15-16/07

Sediment Test
 American Aquatic Testing, Inc.
 Observations / Live Count

Conc.	Rep	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	
											Observ.	Final Live Count
DC-13	A	N	N	N	N	N	N	N	N	N	N	8
	B	N	N	N	IF	N	N	N	N	IF	N	10
	C	N	N	N	N	N	IF	N	N	IF	N	12
	D	N	IF	N	N	N	N	N	N	N	IF	12
	E	N	IF	N	N	IF	IF	N	N	N	IF	12
	F											
	G											
	H											
DC-14	A	N	IF	N	N	N	N	N	N	IF	N	9
	B	N	IF	N	N	N	N	N	N	N	IF	10
	C	IF	2F	N	N	N	N	IF	N	N	N	11
	D	N	N	N	N	N	N	N	N	N	N	12
	E	N	N	IF	N	N	N	N	IF	N	N	10
	F											
	G											
	H											
	A											
	B											
	C											
	D											
	E											
	F											
	G											
	H											
	A											
	B											
	C											
	D											
	E											
	F											
	G											
	H											
Initials												
Date	4/29	TAP 4/30	TAP 5/1	WIL 5/2	MAD 5/3	TAP 5/4	TAP 5/5	TAP 5/6	TAP 5/7	TAP 5/8	TAP 5/9	

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

Client/Toxicant: 146
 Project Number: 04-01
 Species: C. Tentara

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310
 Hatch Date: Deposited 4/15 - 4/16/07

American Aquatic Testing, Inc.
 Weight Data

Conc.	Rep	Pan #	A weight of boat (g)	B weight of boat & org. (g)	(B-A)*1000=C dry weight of organisms (mg)	D # of surviving org.	C/D mean dry weight (mg)	C/E IC ₂₅ & NOEC calc. weight (mg)
Control	A	1	0.01230	0.02625	13.95	11	1.268	
	B	2	0.01122	0.02574	14.52	10	1.452	
	C	3	0.01197	0.02416	12.19	12	1.016	
	D	4	0.01156	0.02788	16.32	10	1.632	
	E	5	0.01219	0.02760	15.41	12	1.284	
	X	-	-	-	-	-	-	
	X	-	-	-	-	-	-	
0C-01	A	6	0.01182	0.02479	12.97	5	2.594	
	B	7	0.01086	0.02522	14.36	11	1.306	
	C	8	0.01247	0.02883	16.36	9	1.818	
	D	9	0.01131	0.02206	10.75	9	1.194	
	E	10	0.00986	0.01982	9.96	2	4.980	
	X	-	-	-	-	-	-	
	X	-	-	-	-	-	-	
0C-03	A	11	0.01037	0.02407	13.70	7	1.957	
	B	12	0.00953	-	-	0	-	
	C	13	0.00953	0.02572	16.19	7	2.313	
	D	14	0.01009	0.02515	15.06	10	1.506	
	E	15	0.00982	0.01810	8.28	5	1.656	
	X	-	-	-	-	-	-	
	X	-	-	-	-	-	-	
0C-05	A	16	0.00888	0.00945	0.57	5	0.114	
	B	17	0.00999	0.00000	-	0	-	
	C	18	0.00948	0.00000	-	0	-	
	D	19	0.01044	0.01083	0.39	4	0.098	
	E	20	0.00906	0.00910	0.04	1	0.040	
	X	-	-	-	-	-	-	
	X	-	-	-	-	-	-	
Initials			9	thd	thd	MAD	thd	
Date			5/8	5/9/07	5/9/07	5/8	5/9/07	

E = Original number of organisms at test initiation, adjusted for losses.

Observations:

Client/Toxicant: 140
 Project Number: 04-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310
 Hatch Date: Deposited 4/15 - 4/16/07

American Aquatic Testing, Inc.
 Weight Data

Conc.	Rep	Pan #	A weight of boat (g)	B weight of boat & org. (g)	(B-A)*1000=C dry weight of organisms (mg)	D # of surviving org.	C/D mean dry weight (mg)	C/E IC ₂₅ & NOEC calc. weight (mg)
0C-07	A	21	0.01024	0.01770	7.46	5	1.492	
	B	22	0.00990	0.00000		0		
	C	23	0.00990	0.01535	6.02	3	2.007	
	D	24	0.01037	0.01558	5.21	3	1.737	
	E	25	0.00912	0.01118	2.06	4	0.515	
	X	-	-	-	-	-	-	
	X	-	-	-	-	-	-	
0C-11	A	26	0.00962	0.01952	9.90	6	1.650	
	B	27	0.00960	0.01940	9.80	7	1.400	
	C	28	0.00919	0.02249	13.30	6	2.217	
	D	29	0.00950	0.01426	4.76	4	1.190	
	E	30	0.00965	0.01427	4.62	3	1.540	
	X	-	-	-	-	-	-	
	X	-	-	-	-	-	-	
0C-14	A	31	0.00967	0.01739	8.32	7	1.189	
	B	32	0.00933	0.01894	9.61	12	0.801	
	C	33	0.00972	0.01671	6.99	4	1.748	
	D	34	0.00882	0.01626	7.44	4	1.860	
	E	35	0.00972	0.01778	8.06	4	2.015	
	X	-	-	-	-	-	-	
	X	-	-	-	-	-	-	
0C-19	A	36	0.00937	0.02085	11.48	7	1.640	
	B	37	0.00979	0.01845	8.66	8	1.083	
	C	38	0.01057	0.01838	7.81	4	1.953	
	D	39	0.01021	0.01899	8.78	6	1.463	
	E	40	0.00992	0.01886	8.94	7	1.277	
	X	-	-	-	-	-	-	
	X	-	-	-	-	-	-	
Initials			CP	Jhd	Jhd	M&P	Jhd	
Date			5/8	5/9/07	5/9/07	5/8	5/9/07	

E = Original number of organisms at test initiation, adjusted for losses.

Observations: 0.00933 CP 5/8

Client/Toxicant: 140
 Project Number: 04-01
 Species: C. tentaculatus

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310
 Hatch Date: April 4/15 - 4/16/07

American Aquatic Testing, Inc.

Weight Data

Conc.	Rep	Pan #	A weight of boat (g)	B weight of boat & org. (g)	(B-A)*1000=C dry weight of organisms (mg)	D # of surviving org.	C/D mean dry weight (mg)	C/E IC ₂₅ & NOEC calc. weight (mg)
OC-22	A	41	0.00930	0.02450	15.20	7	2.171	
	B	42	0.01118	0.02264	11.46	7	1.637	
	C	43	0.00924	0.00000		0		
	D	44	0.01043	0.01054	0.11	1	0.110	
	E	45	0.01045	0.02017	9.72	3	3.240	
	F	-	-	-	-	-	-	
	G	-	-	-	-	-	-	
	H	-	-	-	-	-	-	
OC-26	A	46	0.00972	0.02623	16.51	5	3.302	
	B	47	0.00995	0.00000		0		
	C	48	0.00911	0.02175	12.64	7	1.806	
	D	49	0.00871	0.01489	6.18	3	2.060	
	E	50	0.00968	0.02030	10.62	5 10	1.770	
	F	-	-	-	-	-	-	
	G	-	-	-	-	-	-	
	H	-	-	-	-	-	-	
OC-01	A	51	0.00973	0.00000		0		
	B	52	0.00929	0.02125	11.96	6	1.993	
	C	53	0.00967	0.01892	9.25	7	1.321	
	D	54	0.01017	0.02085	10.68	8	1.335	
	E	55	0.01003	0.01718	7.15	5	1.430	
	F	-	-	-	-	-	-	
	G	-	-	-	-	-	-	
	H	-	-	-	-	-	-	
OC-03	A	56	0.01035	0.02846	18.11	12	1.509	
	B	57	0.01013	0.02533	15.20	10	1.520	
	C	58	0.00947	0.02325	13.78	10	1.378	
	D	59	0.00960	0.02452	14.92	11	1.356	
	E	60	0.01064	0.02489	14.25	8	1.781	
	F	-	-	-	-	-	-	
	G	-	-	-	-	-	-	
	H	-	-	-	-	-	-	
Initials			JD	Thd	Thd	MLP	Thd	
Date			5/8	5/9/07	5/9/07	5/8	5/9/07	

E = Original number of organisms at test initiation, adjusted for losses.

Observations:

① 6 05/09/07 *fy*

Client/Toxicant: 170
 Project Number: 07-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310
 Hatch Date: April 20 4:5 - 4/16/07

American Aquatic Testing, Inc.
 Weight Data

Conc.	Rep	Pan #	A weight of boat (g)	B weight of boat & org. (g)	(B-A)*1000=C dry weight of organisms (mg)	D # of surviving org.	C/D mean dry weight (mg)	C/E IC ₂₅ & NOEC calc. weight (mg)
DC-05	A	61	0.01055	0.01525	4.70	1	4.700	
	B	62	0.01027	0.02137	11.10	3	3.700	
	C	63	0.01107	0.02208	11.01	8	1.376	
	D	64	0.00953	0.02189	12.36	8	1.545	
	E	65	0.00981	0.01884	9.03	4	2.258	
	X	-	-	-	-	-	-	
	Y	-	-	-	-	-	-	
	Z	-	-	-	-	-	-	
DC-08	A	66	0.00981	0.02799	18.18	9	2.020	
	B	67	0.00979	0.02527	15.48	8	1.935	
	C	68	0.01025	0.00000		0		
	D	69	0.01069	0.02800	17.31	10	1.731	
	E	70	0.01069	0.00000		0		
	X	-	-	-	-	-	-	
	Y	-	-	-	-	-	-	
	Z	-	-	-	-	-	-	
DC-10	A	71	0.01062	0.02572	15.10	9	1.678	
	B	72	0.01242	0.03046	18.04	8	2.255	
	C	73	0.00972	0.02545	15.73	12	1.311	
	D	74	0.01011	0.02545	15.34	12	1.278	
	E	75	0.00999	0.02479	14.80	12	1.233	
	X	-	-	-	-	-	-	
	Y	-	-	-	-	-	-	
	Z	-	-	-	-	-	-	
DC-13	A	76	0.00845	0.01773	9.28	8	1.160	
	B	77	0.00853	0.02248	13.95	10	1.395	
	C	78	0.00900	0.02479	15.79	12	1.316	
	D	79	0.00884	0.02457	15.73	12	1.311	
	E	80	0.00926	0.02724	17.98	12	1.498	
	X	-	-	-	-	-	-	
	Y	-	-	-	-	-	-	
	Z	-	-	-	-	-	-	
Initials			Q	thd	thd	MKP	thd	
Date			5/8	5/9/07	5/9/07	5/8	5/9/07	

E = Original number of organisms at test initiation, adjusted for losses.

Observations:

Client/Toxicant: 146
 Project Number: 04-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310
 Hatch Date: Deposited 4/15 - 4/16/07

American Aquatic Testing, Inc.
Weight Data

Conc.	Rep	Pan #	A weight of boat (g)	B weight of boat & org. (g)	(B-A)*1000=C dry weight of organisms (mg)	D # of surviving org.	C/D mean dry weight (mg)	C/E IC ₂₅ & NOEC calc. weight (mg)
DC-14	A	81	0.01235	0.02780	15.45	9	1.717	
	B	82	0.01075	0.02432	13.87	10	1.387	
	C	83	0.01056	0.02682	16.26	11	1.478	
	D	84	0.01014	0.02448	14.34	12	1.195	
	E	85	0.00927	0.02520	15.93	10	1.593	
	R	-						
	S	-						
	T	-						
	A							
	B							
	C							
	D							
	E							
	F							
	G							
	H							
	A							
	B							
	C							
	D							
	E							
	F							
	G							
	H							
	A							
	B							
	C							
	D							
	E							
	F							
	G							
	H							
Initials			Q	Thd	Thd	M&P	Thd	
Date			5/8	5/9/07	5/9/07	5/8	5/9/07	

E = Original number of organisms at test initiation, adjusted for losses.

Observations:

Client/Toxicant: 140
 Job Number: 04-01
 Species: O. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1318

Freshwater Sediment Test
 American Aquatic Testing, Inc.,
 Physical / Chemical Parameters

		Day											
Parameter	Concentration	0	1	2	3	4	5	6	7	8	9	10	
TEMP (C)	Control	22.0	23.0	22.0	22.5	22.0	23.0	22.0	23.0	22.5	22.0	22.5	
	OC-01	22.0	23.0	22.0	22.5	22.0	23.0	22.5	22.5	22.5	22.0	22.5	
	OC-03	22.0	23.0	22.0	22.0	22.0	23.0	22.5	22.5	22.5	22.0	22.5	
	OC-05	22.0	22.5	22.0	22.0	22.0	23.0	22.5	22.5	22.5	22.0	22.0	
	OC-07	22.0	22.5	22.0	22.0	22.0	23.0	22.5	22.5	22.5	22.0	22.5	
	OC-11	22.0	22.5	22.0	22.0	22.0	23.0	23.5	22.5	22.0	22.0	22.0	
	OC-14	22.0	22.5	22.0	22.0	22.0	23.0	23.5	22.5	22.0	22.0	22.0	
	OC-19	22.0	22.5	22.0	22.0	22.0	23.0	23.5	23.0	22.0	22.0	22.0	
	OC-22	22.0	22.0	22.0	22.0	22.0	23.0	24.0	23.0	22.0	22.0	22.0	
	OC-26	22.0	22.0	22.0	22.0	22.0	23.0	24.0	23.0	22.0	22.0	22.0	
	DC-01	22.0	22.0	22.0	22.0	22.0	23.0	24.0	23.0	22.0	22.0	22.0	
Dissolved Oxygen (mg/L)	Control	6.3	6.5	7.1	6.9	6.8	6.9	6.2	6.0	5.7	5.7	6.0	
	OC-01	6.6	6.2	6.6	6.3	6.5	6.8	7.1	7.5	7.3	7.1	6.4	
	OC-03	6.6	6.5	7.2	7.1	7.0	7.1	6.8	6.7	6.2	6.2	6.8	
	OC-05	6.7	6.9	7.4	7.2	7.1	7.2	6.7	6.6	6.9	6.9	6.9	
	OC-07	6.7	6.9	7.2	6.9	7.0	6.7	6.0	6.1	6.0	5.5	6.6	
	OC-11	6.3	6.8	7.1	6.7	6.9	6.9	6.1	6.2	6.0	6.3	6.8	
	OC-14	6.8	7.0	7.3	6.9	7.0	7.2	6.5	6.3	6.3	6.0	6.8	
	OC-19	7.0	6.7	7.1	6.6	6.8	6.8	6.2	6.2	6.6	6.7	6.4	
	OC-22	6.8	6.3	6.6	6.3	6.4	6.6	5.8	5.9	6.1	6.6	6.4	
	OC-26	7.1	7.0	7.5	7.3	7.2	6.8	6.4	6.7	7.0	6.8	7.0	
	DC-01	7.2	6.6	7.3	6.7	6.8	6.7	5.5	5.8	6.0	5.7	6.2	
pH	Control	6.9	7.6	7.7	7.6	7.5	7.6	7.6	7.7	7.9	7.5	7.6	
	OC-01	7.3	7.6	7.7	7.6	7.5	7.5	7.7	7.8	8.1	8.3	8.2	
	OC-03	7.3	7.7	7.8	7.6	7.6	7.7	8.4	8.6	8.6	8.9	8.8	
	OC-05	7.4	7.8	7.8	7.8	7.7	8.3	8.2	8.8	9.0	9.0	8.8	
	OC-07	7.5	7.8	7.9	7.9	7.8	8.3	8.5	8.8	9.1	9.0	8.9	
	OC-11	7.5	7.8	7.9	7.9	7.8	8.4	8.5	8.6	9.0	8.9	8.9	
	OC-14	7.5	7.8	7.9	7.9	7.8	8.3	8.4	8.7	9.1	9.1	8.9	
	OC-19	7.5	7.8	7.9	7.9	7.9	8.3	8.5	8.6	8.9	9.0	9.0	
	OC-22	7.5	7.7	7.8	7.9	7.9	8.4	8.5	8.6	8.9	8.8	8.9	
	OC-26	7.5	7.8	7.8	7.9	7.9	8.4	8.3	8.4	8.8	8.9	8.9	
	DC-01	7.5	7.8	7.9	7.9	7.9	8.5	8.8	8.5	8.9	8.9	8.9	
Initials		hnd	hnd	hnd	hnd	hnd	hnd	hnd	hnd	hnd	hnd	hnd	
Date		4/18/07	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	

Concentration	Cond. (umhos)		Alkalinity (mg/L)		Hardness (mg/L)		Ammonia (mg/L)		Comments:
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	
Control	304	316	80	60	100	130	0.21	0.16	0.75 mV 4/23
OC-01	324	343	90	90	140	180	0.46	0.02	
OC-03	321	351	110	100	150	230	0.56	0.01	
OC-05	336	342	100	100	140	190	0.43	0.11	
OC-07	324	343	100	100	140	180	0.65	0.00	
OC-11	332	361	100	90	130	160	0.82	0.02	
OC-14	378	353	100	110	110	180	0.31	0.08	
OC-19	341	342	100	80	120	150	0.40	0.00	
OC-22	355	366	100	90	130	160	0.89	0.00	
OC-26	353	344	100	100	120	140	0.28	0.02	
DC-01	362	359	100	100	130	170	0.39	0.01	
Initials	hnd	hnd	hnd	hnd	hnd	hnd	hnd	hnd	
Date	4/18/07	4/18	4/18	5/8	4/18	5/8	4/18	5/8	

Client/Toxicant: 140
 Job Number: 04-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310

Freshwater Sediment Test
 American Aquatic Testing, Inc.,
 Physical / Chemical Parameters

Parameter	Concentration	Day										
		0	1	2	3	4	5	6	7	8	9	10
TEMP (C)	DC-03	22.0	22.0	22.0	22.0	22.0	23.0	24.0	23.0	22.0	22.0	22.0
	DC-05	22.0	22.0	22.0	22.0	22.0	23.0	24.0	23.0	22.0	22.0	22.0
	DC-08	22.0	22.0	22.0	22.0	22.0	23.0	24.0	23.0	22.0	22.0	22.0
	DC-10	22.0	22.0	22.0	22.0	22.0	23.0	24.0	22.5	22.0	22.0	22.0
	DC-13	22.0	22.0	22.0	22.0	22.0	23.0	24.0	22.5	22.0	22.0	22.0
	DC-14	22.0	22.0	22.0	22.0	22.0	23.0	24.0	23.0	22.0	22.0	22.0
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Oxygen (mg/L)	DC-03	6.4	6.6	7.1	6.7	6.6	6.7	6.1	6.2	5.9	6.1	6.6
	DC-05	6.7	7.1	7.4	7.0	7.1	6.9	5.8	5.7	5.8	6.0	6.3
	DC-08	7.4	7.3	7.3	6.8	6.9	7.3	5.6	5.9	5.4	5.5	6.1
	DC-10	7.3	7.6	8.3	8.0	7.9	8.0	7.5	7.8	7.9	7.9	6.9
	DC-13	6.6	7.0	7.7	7.3	7.2	7.3	6.0	6.6	6.6	6.5	6.6
	DC-14	7.0	6.7	7.1	6.0	6.2	6.4	4.8	5.9	5.7	5.3	6.0
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
pH	DC-03	7.4	7.8	7.8	7.9	7.8	8.4	8.4	8.3	8.8	8.8	8.7
	DC-05	7.5	7.8	7.9	7.9	7.9	8.5	8.6	8.5	9.0	9.0	8.7
	DC-08	7.6	7.9	7.9	7.9	7.9	8.7	8.9	8.7	9.2	9.0	8.7
	DC-10	7.6	7.9	8.0	8.0	7.9	8.6	8.6	8.5	9.0	8.9	8.9
	DC-13	7.6	7.9	8.0	8.0	8.0	8.7	8.9	8.7	9.1	9.1	8.9
	DC-14	7.7	7.9	7.9	8.0	8.0	8.7	8.8	8.7	9.0	9.0	8.9
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Initials		thd	WDA	WEP	MKP	MKP	WPP	thd	WEP	WEP	WEP	WEP
Date		4/18/07	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28

Concentration	Cond. (umhos)		Alkalinity (mg/L)		Hardness (mg/L)		Ammonia (mg/L)		Comments:
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	
DC-03	357	354	110	90	130	140	0.85	0.01	
DC-05	359	361	110	100	130	200	1.16	0.02	
DC-08	376	391	110	100	140	230	0.43	0.01	
DC-10	348	357	110	110	150	150	1.07	0.03	
DC-13	357	377	100	100	120	140	0.32	0.06	
DC-14	333	364	100	100	120	160	0.24	0.07	
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
Initials	thd	WEP	MKP	WEP	MKP	WPP	TAP	WPP	
Date	4/18/07	5/8	4/18	5/8	4/18	5/8	4/18	5/8	

Client/Toxicant: 140
 Job Number: 04-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310

Freshwater Sediment Test
American Aquatic Testing, Inc.,
Physical / Chemical Parameters

Parameter	Concentration	Day										
		11	12	13	14	15	16	17	18	19	20	21
TEMP (C)	Control		23.5	22.5	23.0	23.0	24.0	23.5	23.0	22.0	22.5	
	OC-01		23.5	22.5	22.5	22.5	24.0	23.0	23.0	22.0	22.5	
	OC-03		23.0	22.0	22.5	22.5	23.5	23.0	23.0	22.0	22.0	
	OC-05		23.0	22.5	22.5	22.5	23.5	23.0	23.0	22.0	22.0	
	OC-07		23.0	22.5	22.5	22.5	23.0	23.0	23.0	22.0	22.0	
	OC-11		23.0	22.5	22.5	22.0	22.5	23.0	23.0	22.0	22.0	
	OC-14		22.5	22.5	22.5	22.0	22.5	23.0	23.0	22.0	22.0	
	OC-19		22.5	22.0	22.5	22.0	22.5	23.0	23.0	22.0	22.0	
	OC-22		22.5	22.0	22.5	22.0	22.5	23.0	23.0	22.0	22.0	
	OC-26		22.5	22.0	22.5	22.0	22.0	22.5	23.0	22.0	22.0	
	DC-01		22.5	22.0	22.5	22.0	22.0	22.5	23.0	22.0	22.0	
Dissolved Oxygen (mg/L)	Control		5.7	6.0	5.6	6.0	5.2	5.5	5.9	6.4	5.5	
	OC-01		6.3	6.2	5.4	5.7	5.2	5.4	5.8	5.3	6.5	
	OC-03		6.7	6.8	7.0	6.1	5.9	6.1	6.3	6.1	7.4	
	OC-05		7.2	7.3	7.0	7.0	6.8	7.0	7.4	8.5	7.9	
	OC-07		6.4	6.2	6.2	6.0	5.7	6.0	6.3	6.2	7.3	
	OC-11		6.8	6.3	6.0	6.1	6.0	6.2	6.7	5.2	5.0	
	OC-14		6.8	6.6	6.2	6.5	6.5	6.6	6.9	6.8	6.8	
	OC-19		7.1	7.0	6.1	5.8	6.3	6.7	7.1	6.2	6.6	
	OC-22		6.8	6.7	6.7	5.4	6.0	6.3	6.6	5.1	5.7	
	OC-26		5.8	5.7	5.2	5.8	5.2	5.8	6.4	6.2	6.4	
	DC-01		6.3	6.4	5.1	6.0	5.9	6.1	6.6	6.4	6.8	
pH	Control		7.7	7.8	7.6	8.0	7.7	7.8	7.9	7.8	7.9	
	OC-01		8.8	8.6	7.9	8.4	8.5	8.6	8.5	8.2	8.2	
	OC-03		9.0	8.9	8.8	8.7	8.8	8.7	8.8	8.5	8.9	
	OC-05		9.0	8.9	8.9	8.8	8.9	8.8	8.9	9.1	8.9	
	OC-07		9.1	9.0	9.0	8.9	8.9	8.8	8.8	8.8	8.9	
	OC-11		8.9	8.9	8.9	8.9	8.8	8.7	8.7	8.5	8.3	
	OC-14		9.0	9.0	8.9	8.8	8.8	8.6	8.7	8.9	8.4	
	OC-19		8.9	8.8	8.8	8.7	8.7	8.5	8.6	8.5	8.4	
	OC-22		8.8	8.7	8.7	8.6	8.5	8.4	8.5	8.4	8.2	
	OC-26		8.9	8.8	8.7	8.6	8.7	8.6	8.7	8.6	8.6	
	DC-01		9.1	9.0	8.9	8.6	9.0	9.0	9.0	9.0	8.6	
	Initials..		MED	MED	MED	MED	MED	TOD	TOD	WDL	TAP	
	Date		4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	

Concentration	Cond. (umhos)		Alkalinity (mg/L)		Hardness (mg/L)		Ammonia (mg/L)		Comments:
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	
Control									
OC-01									
OC-03									
OC-05									
OC-07									
OC-11									
OC-14									
OC-19									
OC-22									
OC-26									
DC-01									
Initials									
Date									

Client/Toxicant: 140
 Job Number: H-01
 Species: C. tentans

Beginning Date & Time: 4-18-07 1520
 Ending Date & Time: 5-8-07 1310

Freshwater Sediment Test
 American Aquatic Testing, Inc.,
 Physical / Chemical Parameters

Parameter	Concentration	Day										
		11	12	13	14	15	16	17	18	19	20	21
TEMP (C)	Control	—	—	—	—	—	—	—	—	—	—	—
	DC-03		22.0	22.0	22.5	22.0	22.0	22.5	23.0	22.0	22.0	
	DC-05		22.0	22.0	22.5	22.0	22.0	22.5	23.0	22.0	22.0	
	DC-08		22.0	22.0	22.5	22.0	22.0	22.5	22.5	22.0	22.0	
	DC-10		22.0	22.0	22.5	22.0	22.0	22.5	22.5	22.0	22.0	
	DC-13		22.0	22.0	22.5	22.0	22.0	22.5	22.5	22.0	22.0	
	DC-14		22.0	22.0	23.0	22.0	22.5	22.5	22.5	22.0	22.5	
	—											
	—											
	—											
Dissolved Oxygen (mg/L)	Control	—	—	—	—	—	—	—	—	—	—	—
	DC-03		6.2	6.3	5.1	5.4	5.7	5.6	6.1	5.8	5.4	
	DC-05		7.1	7.2	5.6	6.3	6.6	6.7	7.0	7.4	6.5	
	DC-08		6.0	5.4	4.9	5.9	6.6	6.5	6.9	4.4	6.0	
	DC-10		6.7	6.2	5.2	6.0	6.3	6.4	6.6	7.2	6.8	
	DC-13		7.0	6.5	4.8	5.8	4.4	5.0	5.4	6.0	5.7	
	DC-14		6.3	5.9	5.1	5.3	5.4	5.6	6.0	5.2	6.0	
	—											
	—											
	—											
pH	Control	—	—	—	—	—	—	—	—	—	—	—
	DC-03		8.6	8.7	8.7	8.5	8.4	8.5	8.6	8.5	8.4	
	DC-05		8.7	8.8	8.8	8.6	8.9	8.8	8.9	9.0	8.6	
	DC-08		8.9	8.8	8.8	8.7	8.5	8.6	8.6	8.6	8.3	
	DC-10		8.9	8.9	8.8	8.7	8.8	8.8	8.8	8.8	8.4	
	DC-13		9.0	8.9	8.9	8.7	8.8	8.7	8.8	8.7	8.3	
	DC-14		8.8	8.7	8.6	8.7	8.5	8.4	8.5	8.5	8.2	
	—											
	—											
	—											
Initials:		MP	MP	K/0	MP	VAL	TOP	TOP	VAL	Q/HP		
Date		4/20	5/1	5/2	5/3	5/4	5/5	5/6	5/6	5/8		

Concentration	Cond. (umhos)		Alkalinity (mg/L)		Hardness (mg/L)		Ammonia (mg/L)		Comments:
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	
Control	—	—	—	—	—	—	—	—	
DC-03									
DC-05									
DC-08									
DC-10									
DC-13									
DC-14									
—									
—									
—									
Initials									
Date									

Job Number: 140-04-01
Species: C. tentans

Start Date & Time: 4-18-07 1526
End Date & Time: 5-8-07 1310

Sediment Test
American Aquatic Testing, Inc.,
Water Change Log/Initial Water Readings/General Testing Information

Test Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Morning change(time)	0740	910	930	950	915	900	915	1020	845	0815	0950	0850	900	930	0920
D.O. mg/L	8.8	8.7	8.6	8.6	8.8	8.7	8.5	8.1	8.7	8.9	8.6	8.4	9.0	8.9	8.3
pH	7.2	8.1	7.9	8.0	8.0	8.4	8.3	7.8	8.1	8.0	8.0	8.1	8.2	8.3	8.5
Temp. (C)	22.0	22.0	22.0	22.0	23.0	23.0	24.0	24.0	23.0	23.0	23.0	23.0	22.0	23.0	23.0
Initials		TRP	TRP	MKP	MKP	TRP	TRP	TRP	TRP	TRP	TRP	TRP	TRP	TRP	TRP
Date		4/18	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	04/28	04/29	4/30	5/1	5/2
Afternoon change(time)	0740	1605	1550	1535	1500	1655	1745	1630	1635	1700	1830	1845	1515	1630	1520
D.O. mg/L	8.9	8.7	8.5	8.6	8.5	8.6	8.3	8.1	8.4	8.4	8.5	8.3	8.7	8.0	8.5
pH	8.1	8.0	8.0	8.1	8.1	8.2	8.1	7.7	8.0	8.2	8.1	8.1	8.0	7.8	8.0
Temp. (C)	22.0	22.5	22.5	22.0	22.0	23.5	24.0	23.5	23.0	22.5	23.0	23.0	22.0	22.0	22.5
Initials	TRP	TRP	MKP	MKP	MKP	TRP	TRP	TRP	TRP	MKP	TRP	TRP	MKP	MKP	MKP
Date	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	04/28	04/29	4/30	5/1	5/2

Test Day	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Morning change(time)	0945	0935	920	900	940	0815								
D.O. mg/L	8.6	8.4	8.5	8.6	8.7	8.6								
pH	8.4	8.3	8.3	8.3	8.2	7.9								
Temp. (C)	22.5	23.0	23.0	22.5	22.5	23.0								
Initials	MKP	MKP	TRP	TRP	TRP	MKP								
Date	5/3	5/4	5/5	5/6	5/7	5/8								
Afternoon change(time)	1630	1530	1610	1715	1830									
D.O. mg/L	8.3	8.4	8.4	8.4	8.5									
pH	8.3	8.1	8.2	8.4	8.2									
Temp. (C)	22.0	22.0	23.5	23.0	23.0									
Initials	MKP	MKP	TRP	TRP	TRP									
Date	5/3	5/4	5/5	5/6	05/07									

Control Sed. collection date/by: 4/12/07/TRP

Organism source: ABS Inc.

Test Chamber size: 300ml

Control Sed. sieve date/by: 4/13/07/TRP

Test organism Lot number: 943

Test Volume of sediment: 100ml

Sieve size used: 1mm

Number of animals per chamber: 12

Test Volume of water: 175ml

Sample sieve date/by: 4/11 & 4/12/07/TRP

Food Type: Flake

Test Duration: 20 days

Sieve size used: 1mm

Frequency of feeding: once every other day

Test Temperature Range: 23±1°C

①1300 - TRP 4/18

APPENDIX B

STATISTICAL ANALYSIS OF *Chironomus tentans* 20 DAY

SURVIVAL AND GROWTH TEST RESULTS

TETRATECH OTTER CREEK OC-A Survival

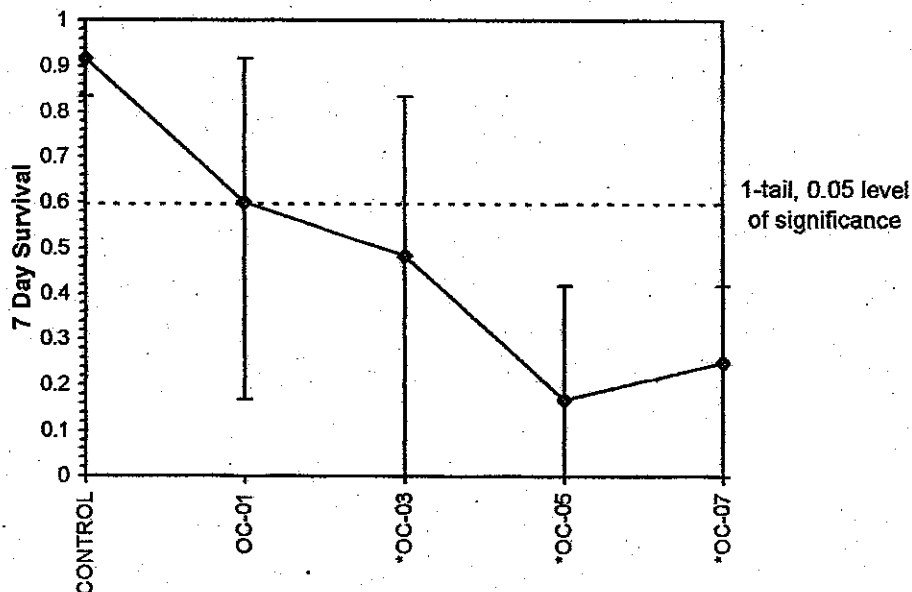
Start Date: 4/18/2007 Test ID: 14004OCa Sample ID: TETRATECH
 End Date: 5/8/2007 Lab ID: Sample Type: SEDIMENT
 Sample Date: Protocol: EPAF 94-EPA Freshwater Test Species: CT -Chironomus tentans
 Comments:

Conc-%	1	2	3	4	5
CONTROL	0.9167	0.8333	1.0000	0.8333	1.0000
OC-01	0.4167	0.9167	0.7500	0.7500	0.1667
OC-03	0.5833	0.0000	0.5833	0.8333	0.4167
OC-05	0.4167	0.0000	0.0000	0.3333	0.0833
OC-07	0.4167	0.0000	0.2500	0.2500	0.3333

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					t-Stat	1-Tailed Critical	MSD
			Mean	Min	Max	CV%	N			
CONTROL	0.9167	1.0000	1.2861	1.1503	1.4260	10.724	5			
OC-01	0.6000	0.6545	0.8989	0.4205	1.2780	37.536	5	2.201	2.300	0.4046
*OC-03	0.4833	0.5273	0.7470	0.1448	1.1503	49.959	5	3.065	2.300	0.4046
*OC-05	0.1667	0.1818	0.3799	0.1448	0.7017	69.277	5	5.152	2.300	0.4046
*OC-07	0.2500	0.2727	0.5018	0.1448	0.7017	42.416	5	4.459	2.300	0.4046

Auxiliary Tests	Statistic	Critical	Skew	Kurt		
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.9589	0.888	-0.6123	0.10565		
Bartlett's Test indicates equal variances (p = 0.42)	3.9015	13.2767				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates significant differences Treatments vs CONTROL	0.32557	0.35346	0.6341	0.07735	4.4E-04	4, 20

Dose-Response Plot



TETRATECH OTTER CREEK OC-A Growth

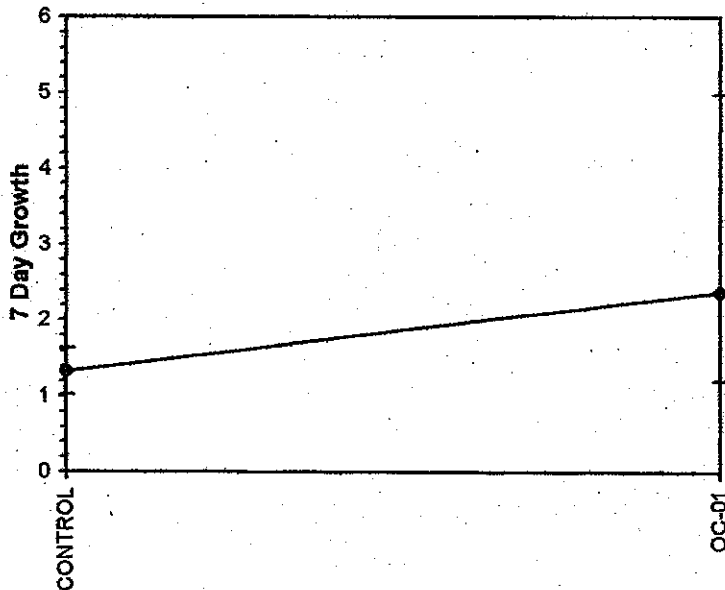
Start Date: 4/18/2007 Test ID: 14004OCa Sample ID: TETRATECH
 End Date: 5/8/2007 Lab ID: SEDIMENT
 Sample Date: Protocol: EPAF 94-EPA Freshwater Test Species: CT-Chironomus tentans
 Comments:

Conc-%	1	2	3	4	5
CONTROL	1.2682	1.4520	1.0158	1.6320	1.2842
OC-01	2.5940	1.3055	1.8178	1.1944	4.9800

Conc-%	Mean	N-Mean	Transform: Untransformed					Rank Sum	1-Tailed Critical
			Mean	Min	Max	CV%	N		
CONTROL	1.3304	1.0000	1.3304	1.0158	1.6320	17.251	5		
OC-01	2.3783	1.7876	2.3783	1.1944	4.9800	65.416	5	34.00	19.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution ($p > 0.01$)	0.81822	0.781	1.7532	4.55236
F-Test indicates unequal variances ($p = 2.68E-03$)	45.9497	23.1539		
Hypothesis Test (1-tail, 0.05)				
Wilcoxon Two-Sample Test indicates no significant differences				
Treatments vs CONTROL				

Dose-Response Plot



TETRATECH OTTER CREEK OC-B Survival

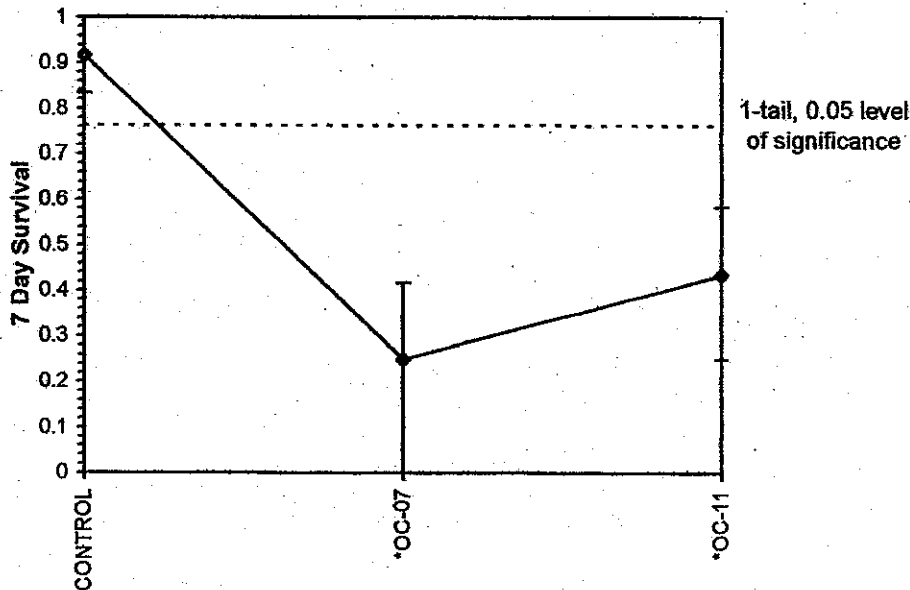
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 End Date: 5/8/2007 Lab ID: Sample Type: SEDIMENT
 Sample Date: Protocol: EPAF 94-EPA Freshwater Test Species: CT-Chironomus tentans
 Comments:

Conc-%	1	2	3	4	5
CONTROL	0.9167	0.8333	1.0000	0.8333	1.0000
OC-07	0.4167	0.0000	0.2500	0.2500	0.3333
OC-11	0.5000	0.5833	0.5000	0.3333	0.2500

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					t-Stat	1-Tailed	
			Mean	Min	Max	CV%	N		Critical	MSD
CONTROL	0.9167	1.0000	1.2861	1.1503	1.4260	10.724	5			
*OC-07	0.2500	0.2727	0.5018	0.1448	0.7017	42.416	5	7.394	2.110	0.2238
*OC-11	0.4333	0.4727	0.7158	0.5236	0.8691	19.782	5	5.376	2.110	0.2238

Auxiliary Tests	Statistic	Critical	Skew	Kurt		
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.92717	0.835	-0.8674	0.29848		
Bartlett's Test indicates equal variances (p = 0.63)	0.91034	9.21035				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates significant differences Treatments vs CONTROL	0.15817	0.17171	0.82169	0.02813	2.4E-05	2, 12

Dose-Response Plot



TETRATECH OTER CREEK OC-C Survival

Start Date: 4/18/2007 Test ID: 14004OCb Sample ID: TETRATECH
 End Date: 5/8/2007 Lab ID: Sample Type: SEDIMENT
 Sample Date: Protocol: EPAF 94-EPA Freshwater Test Species: CT-Chironomus tentans
 Comments:

Conc-%	1	2	3	4	5
CONTROL	0.9167	0.8333	1.0000	0.8333	1.0000
OC-11	0.5000	0.5833	0.5000	0.3333	0.2500
OC-14	0.5833	1.0000	0.3333	0.3333	0.3333

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					t-Stat	1-Tailed	
			Mean	Min	Max	CV%	N		Critical	MSD
CONTROL	0.9167	1.0000	1.2861	1.1503	1.4260	10.724	5			
*OC-11	0.4333	0.4727	0.7158	0.5236	0.8691	19.782	5	3.871	2.110	0.3108
*OC-14	0.5167	0.5636	0.8283	0.6155	1.4260	42.459	5	3.108	2.110	0.3108

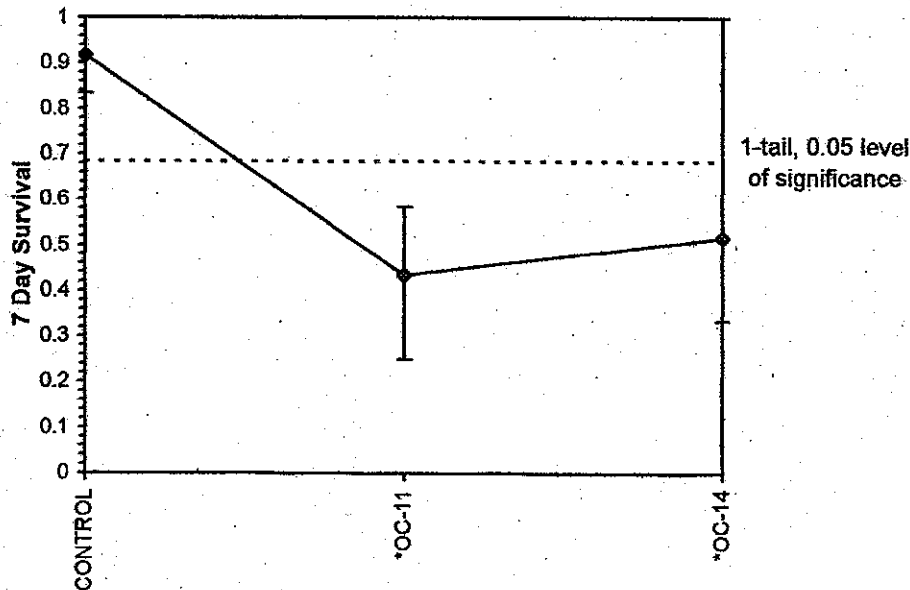
Auxiliary Tests

Shapiro-Wilk's Test indicates normal distribution ($p > 0.01$) Statistic: 0.84292 Critical: 0.835 Skew: 1.48972 Kurt: 3.20566
 Bartlett's Test indicates equal variances ($p = 0.11$) Statistic: 4.38966 Critical: 9.21035

Hypothesis Test (1-tail, 0.05)

Dunnett's Test indicates significant differences MS Du: 0.23578 MS Dp: 0.25598 MS B: 0.45619 MSE: 0.05425 F-Prob: 0.00521 df: 2, 12
 Treatments vs CONTROL

Dose-Response Plot



TETRATECH OTTER CREEK OC-D Survival

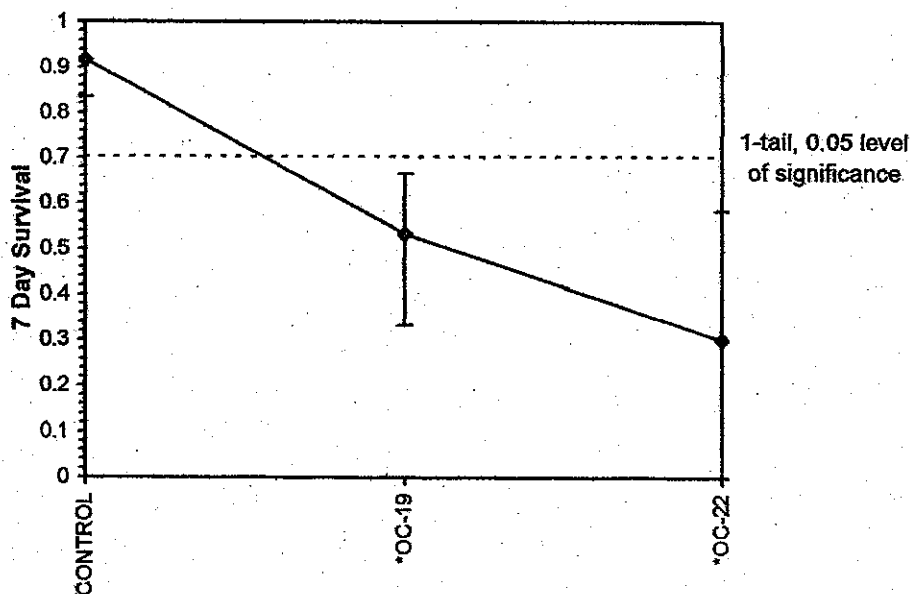
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End Date: 5/8/2007	Lab ID:	Sample Type: SEDIMENT
Sample Date:	Protocol: EPAF 94-EPA Freshwater	Test Species: CT Chironomus tentans
Comments:		

Conc-%	1	2	3	4	5
CONTROL	0.9167	0.8333	1.0000	0.8333	1.0000
OC-19	0.5833	0.6667	0.3333	0.5000	0.5833
OC-22	0.5833	0.5833	0.0000	0.0833	0.2500

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					t-Stat	1-Tailed	
			Mean	Min	Max	CV%	N		Critical	MSD
CONTROL	0.9167	1.0000	1.2861	1.1503	1.4260	10.724	5			
*OC-19	0.5333	0.5818	0.8189	0.6155	0.9553	15.705	5	3.371	2.110	0.2925
*OC-22	0.3000	0.3273	0.5399	0.1448	0.8691	61.020	5	5.383	2.110	0.2925

Auxiliary Tests	Statistic	Critical	Skew	Kurt		
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97078	0.835	-0.1044	-0.1972		
Bartlett's Test indicates equal variances (p = 0.12)	4.23803	9.21035				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates significant differences	0.21886	0.2376	0.71072	0.04803	5.8E-04	2, 12
Treatments vs CONTROL						

Dose-Response Plot



TETRATECH OTTER CREEK OC-E Survival

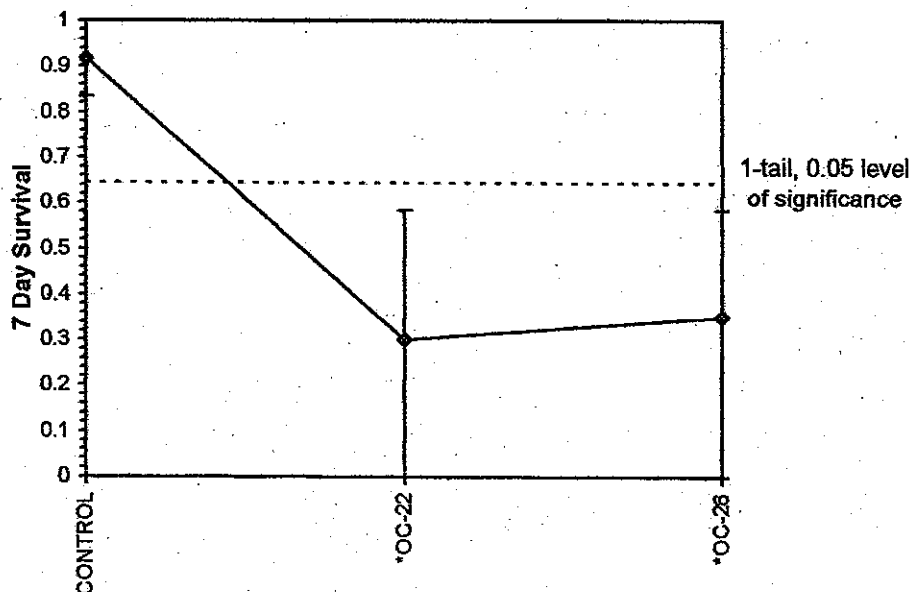
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 End Date: 5/8/2007 Lab ID: Sample Type: SEDIMENT
 Sample Date: Protocol: EPAF 94-EPA Freshwater Test Species: CT-Chironomus tentans
 Comments:

Conc-%	1	2	3	4	5
CONTROL	0.9167	0.8333	1.0000	0.8333	1.0000
OC-22	0.5833	0.5833	0.0000	0.0833	0.2500
OC-26	0.4167	0.0000	0.5833	0.2500	0.5000

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					t-Stat	1-Tailed Critical	MSD
			Mean	Min	Max	CV%	N			
CONTROL	0.9167	1.0000	1.2861	1.1503	1.4260	10.724	5			
*OC-22	0.3000	0.3273	0.5399	0.1448	0.8691	61.020	5	4.459	2.110	0.3531
*OC-26	0.3500	0.3818	0.6049	0.1448	0.8691	47.483	5	4.070	2.110	0.3531

Auxiliary Tests		Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)		0.95237		0.835		-0.4351	-0.5997
Bartlett's Test indicates equal variances (p = 0.28)		2.52307		9.21035			
Hypothesis Test (1-tail, 0.05)		MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates significant differences		0.27568	0.29929	0.85414	0.07002	0.00128	2, 12
Treatments vs CONTROL							

Dose-Response Plot



TETRATECH DUCK CREEK DC-A Survival

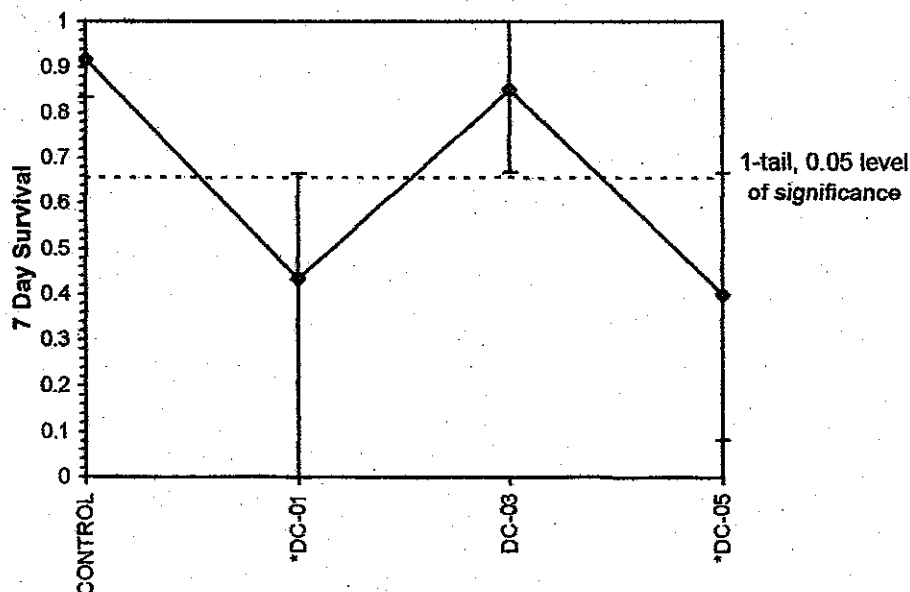
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End Date: 5/8/2007	Lab ID:	Sample Type: SEDIMENT
Sample Date:	Protocol: EPAF 94-EPA Freshwater	Test Species: CT-Chironomus tentans
Comments:		

Conc-%	1	2	3	4	5
CONTROL	0.9167	0.8333	1.0000	0.8333	1.0000
DC-01	0.0000	0.5000	0.5833	0.6667	0.4167
DC-03	1.0000	0.8333	0.8333	0.9167	0.6667
DC-05	0.0833	0.2500	0.6667	0.6667	0.3333

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					t-Stat	1-Tailed	
			Mean	Min	Max	CV%	N		Critical	MSD
CONTROL	0.9167	1.0000	1.2861	1.1503	1.4260	10.724	5			
*DC-01	0.4333	0.4727	0.6913	0.1448	0.9553	46.252	5	3.888	2.230	0.3411
DC-03	0.8500	0.9273	1.1919	0.9553	1.4260	14.629	5	0.615	2.230	0.3411
*DC-05	0.4000	0.4364	0.6685	0.2928	0.9553	42.930	5	4.037	2.230	0.3411

Auxiliary Tests	Statistic	Critical	Skew	Kurt		
Shapiro-Wilk's Test indicates normal distribution ($p > 0.01$)	0.94216	0.868	-0.785	0.52722		
Bartlett's Test indicates equal variances ($p = 0.36$)	3.18008	11.3449				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates significant differences Treatments vs CONTROL	0.26425	0.28689	0.52884	0.0585	9.8E-04	3, 16

Dose-Response Plot



A

TETRATECH DUCK CREEK DC-A Growth

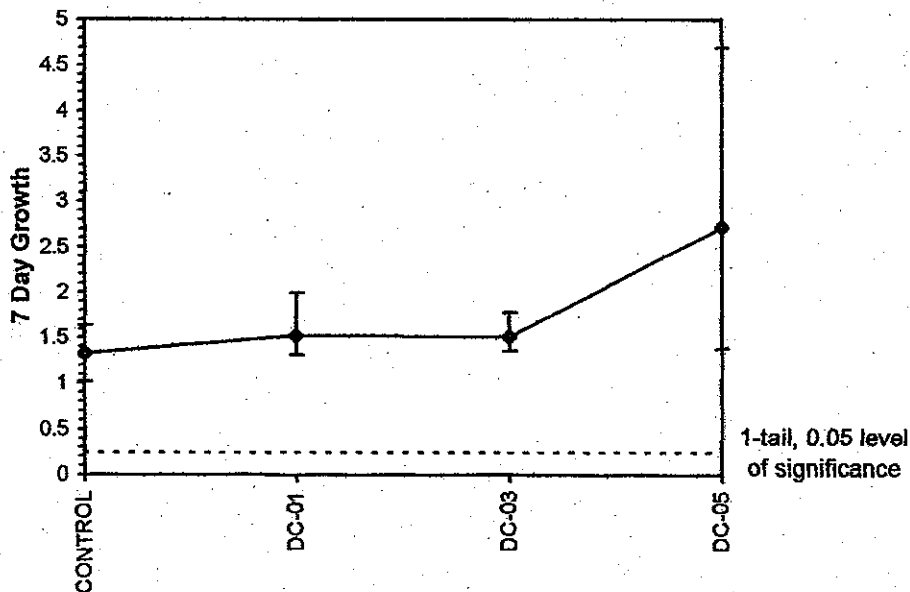
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 End Date: 5/8/2007 Lab ID: Sample Type: SEDIMENT
 Sample Date: Protocol: EPAF 94-EPA Freshwater Test Species: CT-Chironomus tentans
 Comments:

Conc-%	1	2	3	4	5
CONTROL	1.2682	1.4520	1.0158	1.6320	1.2842
DC-01	1.9933	1.3214	1.3350	1.4300	
DC-03	1.5092	1.5200	1.3780	1.3564	1.7813
DC-05	4.7000	3.7000	1.3763	1.5450	2.2575

Conc-%	Mean	N-Mean	Transform: Untransformed					N	t-Stat	1-Tailed	
			Mean	Min	Max	CV%				Critical	MSD
CONTROL	1.3304	1.0000	1.3304	1.0158	1.6320	17.251		5			
DC-01	1.5199	1.1424	1.5199	1.3214	1.9933	21.005		4	-0.366	2.240	1.1582
DC-03	1.5090	1.1342	1.5090	1.3564	1.7813	11.222		5	-0.366	2.240	1.0920
DC-05	2.7158	2.0412	2.7158	1.3763	4.7000	52.981		5	-2.842	2.240	1.0920

Auxiliary Tests	Statistic	Critical	Skew	Kurt		
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.88023	0.863	0.84924	3.28432		
Bartlett's Test indicates unequal variances (p = 1.81E-04)	19.867	11.3449				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates no significant differences	1.092	0.82078	2.00882	0.59414	0.04625	3, 15
Treatments vs CONTROL						

Dose-Response Plot



TETRATECH DUCK CREEK DC-B Survival

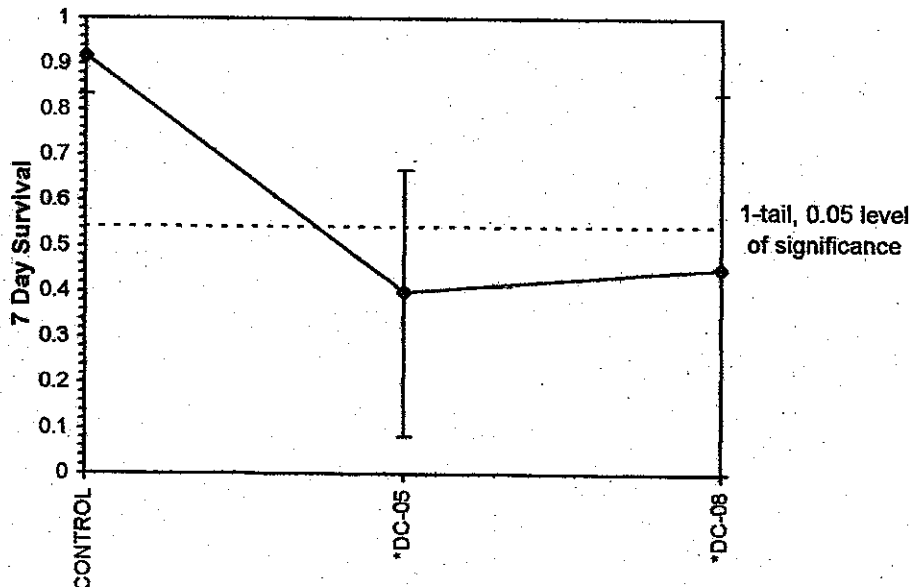
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 End Date: 5/8/2007 Lab ID: Sample Type: SEDIMENT
 Sample Date: Protocol: EPAF 94-EPA Freshwater Test Species: CT-Chironomus tentans
 Comments:

Conc-%	1	2	3	4	5
CONTROL	0.9167	0.8333	1.0000	0.8333	1.0000
DC-05	0.0833	0.2500	0.6667	0.6667	0.3333
DC-08	0.7500	0.6667	0.0000	0.8333	0.0000

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					t-Stat	1-Tailed Critical	MSD
			Mean	Min	Max	CV%	N			
CONTROL	0.9167	1.0000	1.2861	1.1503	1.4260	10.724	5			
*DC-05	0.4000	0.4364	0.6685	0.2928	0.9553	42.930	5	2.849	2.110	0.4574
*DC-08	0.4500	0.4909	0.6885	0.1448	1.1503	72.775	5	2.757	2.110	0.4574

Auxiliary Tests		Statistic		Critical	Skew	Kurt	
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)		0.9374		0.835	-0.4289	-0.7657	
Bartlett's Test indicates equal variances (p = 0.08)		5.09897		9.21035			
Hypothesis Test (1-tail, 0.05)		MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates significant differences		0.37787	0.41024	0.61574	0.11748	0.02312	2, 12
Treatments vs CONTROL							

Dose-Response Plot



TETRATECH DUCK CREEK DC-C Survival

Start Date: 4/18/2007 Test ID: 14004DCc Sample ID: TETRATECH
 End Date: 5/8/2007 Lab ID: Sample Type: SEDIMENT
 Sample Date: Protocol: EPAF 94-EPA Freshwater Test Species: CT-Chironomus tentans
 Comments:

Conc-%	1	2	3	4	5
CONTROL	0.9167	0.8333	1.0000	0.8333	1.0000
DC-08	0.7500	0.6667	0.0000	0.8333	0.0000
DC-10	0.7500	0.6667	1.0000	1.0000	1.0000

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					t-Stat	1-Tailed	
			Mean	Min	Max	CV%	N		Critical	MSD
CONTROL	0.9167	1.0000	1.2861	1.1503	1.4260	10.724	5			
*DC-08	0.4500	0.4909	0.6885	0.1448	1.1503	72.775	5	2.870	2.110	0.4394
DC-10	0.8833	0.9636	1.2561	0.9553	1.4260	18.699	5	0.144	2.110	0.4394

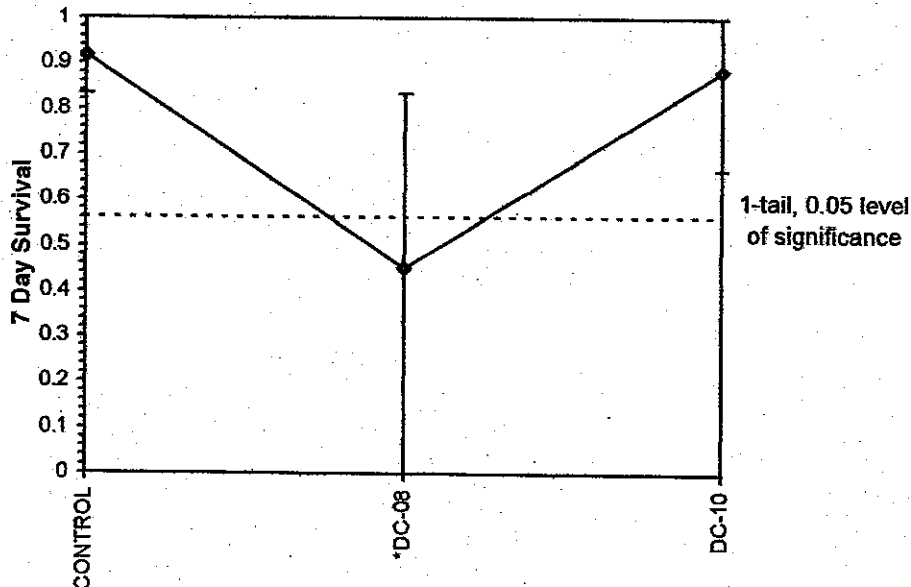
Auxiliary Tests

	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution ($p > 0.01$)	0.93605	0.835	-0.5205	-0.5136
Bartlett's Test indicates equal variances ($p = 0.06$)	5.67451	9.21035		

Hypothesis Test (1-tail, 0.05)

	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates no significant differences Treatments vs CONTROL	0.35997	0.3908	0.5668	0.10841	0.02328	2, 12

Dose-Response Plot



TETRATECH DUCK CREEK DC-C Growth

Start Date: 4/18/2007	Test ID: 14004DCc	Sample ID: TETRATECH
End Date: 5/8/2007	Lab ID:	Sample Type: SEDIMENT
Sample Date:	Protocol: EPAF 94-EPA Freshwater	Test Species: CT-Chironomus tentans
Comments:		

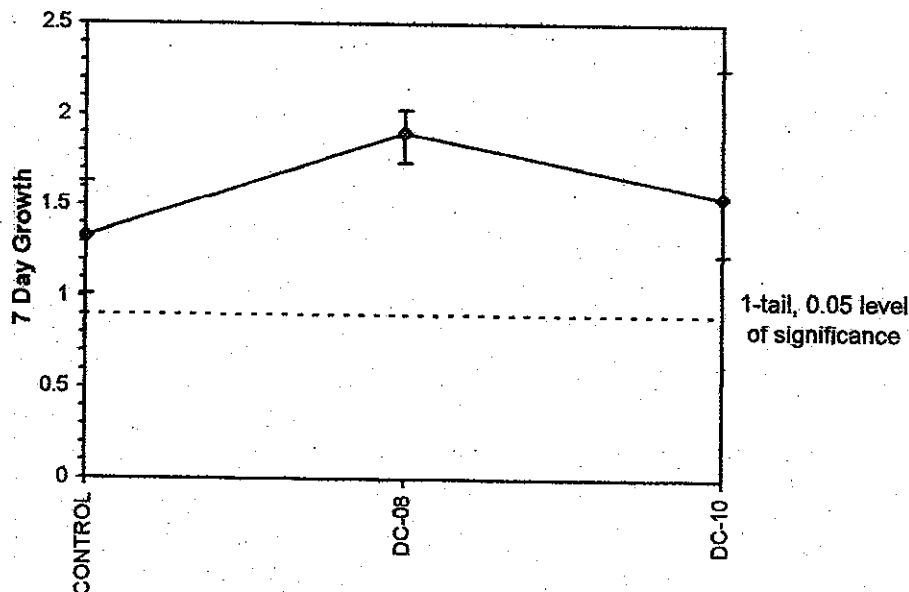
Conc-%	1	2	3	4	5
CONTROL	1.2682	1.4520	1.0158	1.6320	1.2842
DC-08	2.0200	1.9350	1.7310		
DC-10	1.6778	2.2550	1.3108	1.2783	1.2333

Conc-%	Mean	N-Mean	Transform: Untransformed					t-Stat	1-Tailed Critical	MSD
			Mean	Min	Max	CV%	N			
CONTROL	1.3304	1.0000	1.3304	1.0158	1.6320	17.251	5			
DC-08	1.8953	1.4246	1.8953	1.7310	2.0200	7.836	3	-2.447	2.150	0.4964
DC-10	1.5511	1.1658	1.5511	1.2333	2.2550	27.817	5	-1.103	2.150	0.4299

Auxiliary Tests

Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	Statistic	Critical	Skew	Kurt		
Bartlett's Test indicates equal variances (p = 0.26)	0.89906	0.814	1.14703	1.72042		
	2.69183	9.21035				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates no significant differences	0.42988	0.32311	0.29928	0.09995	0.0957	2, 10
Treatments vs CONTROL						

Dose-Response Plot



TETRATECH DUCK CREEK DC-D Survival

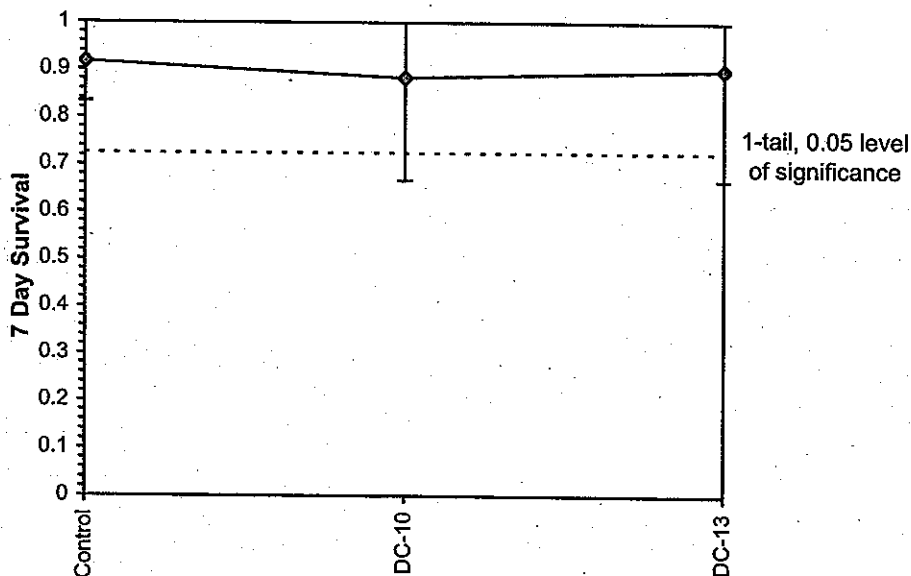
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 End Date: 5/8/2007 Lab ID: Sample Type: SEDIMENT
 Sample Date: Protocol: EPAF 94-EPA/600/4-91/002 Test Species: CT-Chironomus tentans
 Comments:

Conc-%	1	2	3	4	5
Control	0.9167	0.8333	1.0000	0.8333	1.0000
DC-10	0.7500	0.6667	1.0000	1.0000	1.0000
DC-13	0.6667	0.8333	1.0000	1.0000	1.0000

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					t-Stat	1-Tailed Critical	MSD
			Mean	Min	Max	CV%	N			
Control	0.9167	1.0000	1.2861	1.1503	1.4260	10.724	5			
DC-10	0.8833	0.9636	1.2561	0.9553	1.4260	18.699	5	0.236	2.110	0.2677
DC-13	0.9000	0.9818	1.2767	0.9553	1.4260	16.895	5	0.074	2.110	0.2677

Auxiliary Tests		Statistic		Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)		0.81123		0.835	-0.5968	-1.3265
Bartlett's Test indicates equal variances (p = 0.59)		1.03851		9.21035		
Hypothesis Test (1-tail, 0.05)		MSDu	MSDp	MSB	MSE	F-Prob
Dunnett's Test indicates no significant differences Treatments vs Control		0.19645	0.21328	0.00118	0.04024	0.97123
						2, 12

Dose-Response Plot



TETRATECH DUCK CREEK DC-D Growth

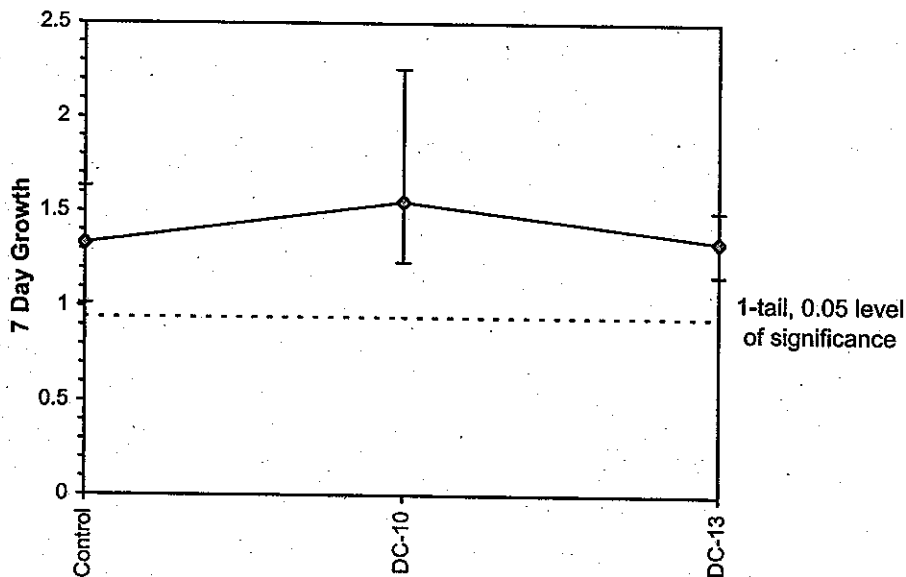
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End Date: 5/8/2007	Lab ID:	Sample Type: SEDIMENT
Sample Date:	Protocol: EPAF 94-EPA/600/4-91/002	Test Species: CT-Chironomus tentans
Comments:		

Conc-%	1	2	3	4	5
Control	1.2682	1.4520	1.0158	1.6320	1.2842
DC-10	1.6778	2.2550	1.3108	1.2783	1.2333
DC-13	1.1600	1.3950	1.3158	1.3108	1.4983

Conc-%	Mean	N-Mean	Transform: Untransformed					t-Stat	1-Tailed	
			Mean	Min	Max	CV%	N		Critical	MSD
Control	1.3304	1.0000	1.3304	1.0158	1.6320	17.251	5			
DC-10	1.5511	1.1658	1.5511	1.2333	2.2550	27.817	5	-1.198	2.110	0.3885
DC-13	1.3360	1.0042	1.3360	1.1600	1.4983	9.307	5	-0.030	2.110	0.3885

Auxiliary Tests		Statistic		Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)		0.90486		0.835	1.18421	2.16019
Bartlett's Test indicates equal variances (p = 0.08)		5.00575		9.21035		
Hypothesis Test (1-tail, 0.05)		MSDu	MSDp	MSB	MSE	F-Prob
Dunnett's Test indicates no significant differences		0.38853	0.29203	0.07913	0.08477	0.41995
Treatments vs Control						2, 12

Dose-Response Plot



TETRATECH DUCK CREEK DC-E Survival

Start Date: 4/18/2007	Test ID: 14004DCe	Sample ID: TETRA TECH
End Date: 5/8/2007	Lab ID:	Sample Type: SEDIMENT
Sample Date:	Protocol: EPAF 94-EPA/600/4-91/002	Test Species: CT-Chironomus tentans
Comments:		

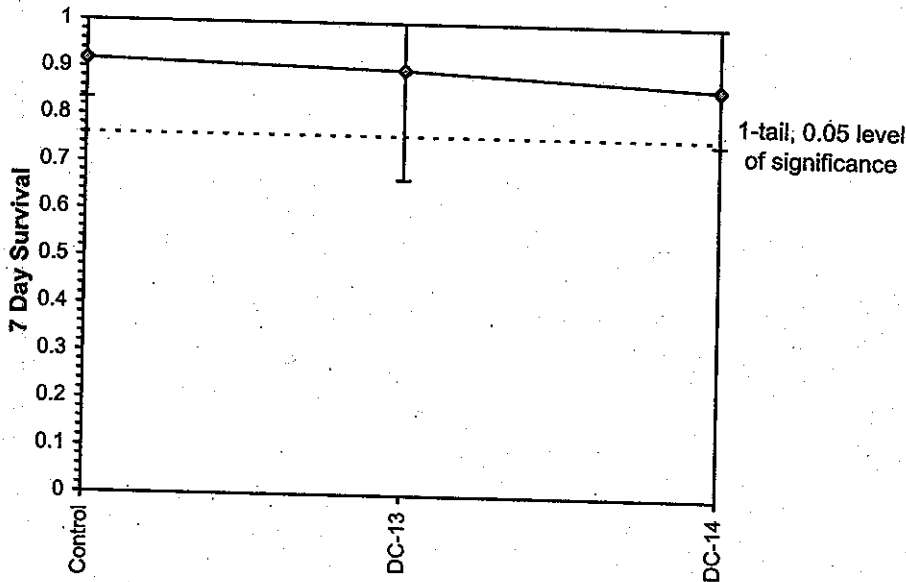
Conc-%	1	2	3	4	5
Control	0.9167	0.8333	1.0000	0.8333	1.0000
DC-13	0.6667	0.8333	1.0000	1.0000	1.0000
DC-14	0.7500	0.8333	0.9167	1.0000	0.8333

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					t-Stat	1-Tailed Critical	MSD
			Mean	Min	Max	CV%	N			
Control	0.9167	1.0000	1.2861	1.1503	1.4260	10.724	5			
DC-13	0.9000	0.9818	1.2767	0.9553	1.4260	16.895	5	0.087	2.110	0.2270
DC-14	0.8667	0.9455	1.2103	1.0472	1.4260	12.037	5	0.704	2.110	0.2270

Auxiliary Tests

Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	Statistic	Critical	Skew	Kurt		
Bartlett's Test indicates equal variances (p = 0.63)	0.91534	0.835	-0.4056	-0.7702		
Hypothesis Test (1-tail, 0.05)	0.9118	9.21035				
Dunnett's Test indicates no significant differences	MSDu	MSDp	MSB	MSE	F-Prob	df
Treatments vs Control	0.16085	0.17462	0.00853	0.02892	0.74996	2, 12

Dose-Response Plot



TETRATECH DUCK CREEK DC-E Growth

Start Date: 4/18/2007

End Date: 5/8/2007

Sample Date:

Comments:

Test ID: 14004DCe

Lab ID:

Protocol: EPAF 94-EPA/600/4-91/002

Sample ID:

Sample Type:

Test Species:

TETRA TECH

SEDIMENT

CT-Chironomus tentans

Conc-%	1	2	3	4	5
Control	1.2682	1.4520	1.0158	1.6320	1.2842
DC-13	1.1600	1.3950	1.3158	1.3108	1.4983
DC-14	1.7167	1.3870	1.4782	1.1950	1.5930

Conc-%	Mean	N-Mean	Transform: Untransformed				N	t-Stat	1-Tailed Critical	MSD
			Mean	Min	Max	CV%				
Control	1.3304	1.0000	1.3304	1.0158	1.6320	17.251	5			
DC-13	1.3360	1.0042	1.3360	1.1600	1.4983	9.307	5	-0.046	2.110	0.2529
DC-14	1.4740	1.1079	1.4740	1.1950	1.7167	13.504	5	-1.197	2.110	0.2529

Auxiliary Tests

Shapiro-Wilk's Test indicates normal distribution ($p > 0.01$)

Bartlett's Test indicates equal variances ($p = 0.52$)

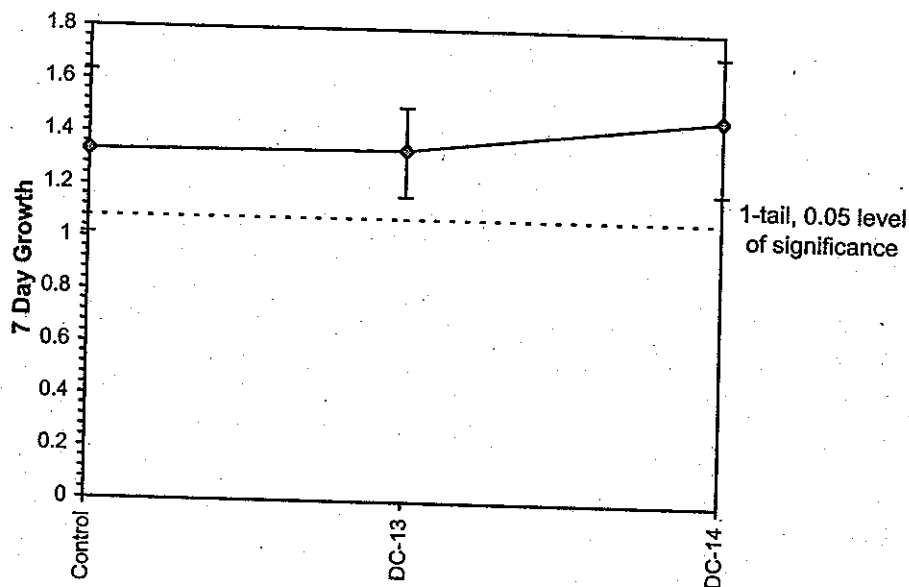
Hypothesis Test (1-tail, 0.05)

Dunnett's Test indicates no significant differences

Treatments vs Control

Statistic		Critical		Skew	Kurt
0.97547		0.835		-0.147	-0.3198
1.30301		9.21035			
MSDu	MSDp	MSB	MSE	F-Prob	df
0.25292	0.1901	0.03306	0.03592	0.42477	2, 12

Dose-Response Plot



APPENDIX C
CHAIN OF CUSTODY DOCUMENTATION

AMERICAN AQUATIC TESTING, INC.

890 North Graham St.
ALLENTOWN, PA 18109
610 434 9015

Job #: 140-04-01

Client:

Address:

Phone #:

SULTRAC

1 South Wacker, 37th Fl, Chicago, IL 60606
312-201-7788

Client Contact:

CHAIN OF CUSTODY

Jack Brunner

Sample

Return to client ☐

Disposal:

Lab disposal ☒

Initial Chemistry Upon Arrival @ Laboratory							SAMPLE INFORMATION					Toxicity Testing Requested			
Sample #	Temp °C	Dis. O ₂	pH	Alk. mg/L	Hard. mg/L	Cl- mg/L	Sample Identification	Sample Type C = Comp G = Grab	Sample Volume	Sample Date	Sample Time	Acute	Chronic	Sediment	Other
	3.5						OC-SED-01	C	1 GAL	4/2/07	11:55				
	↓						OC-SED-11	C		4/3/07	11:51			X	
							OC-SED-10	C		4/3/07	10:56			X	
	↓						OC-SED-22	C		4/3/07	16:26			X	
							OC-SED-03	C		4/2/07	12:45			X	

Samples were:

1. Collected by AAT personnel ☐
Client personnel ☒

2. Transported on ice? ☐
Yes ☒ No ☐

3. Received with in holding time? ☐
Yes ☒ No ☐

4. Sample matrix is:

Liquid ☐ Sediment ☒
Soil ☐ Other ☐

CUSTODY INFORMATION									
Sample #	Relinquished by:	Received by:	Date	Time	Relinquished by:	Received for Lab:	Date	Time	Lab Use ISTN#
OC-SED-01	<u>[Signature]</u>	<u>FEDEX</u>	4/4/07	1700	<u>FEDEX</u>	<u>Ch. S. Nalley</u>	04/05/07	0900	07277
OC-SED-11	<u>[Signature]</u>								07278
OC-SED-10	<u>[Signature]</u>								07279
OC-SED-22	<u>[Signature]</u>								07280
OC-SED-03	<u>[Signature]</u>								07281

Special Instructions: Dilution water collection date(s) N/A

Will ammonia be analyzed on these samples?

Will additional parameters be analyzed on these samples?

Yes ☒

No ☐

Yes ☐

No ☒

AMERICAN AQUATIC TESTING, INC.

890 North Graham St.
ALLENTOWN, PA 18109
610 434 9015

Job #: 140-04-01

Client: Sul TRAC

Address: 1 South Wacker 37th Fl, Chicago, IL 60606

Phone #: 312-201-7788

CHAIN OF CUSTODY

Client Contact: Jack Brunner

Sample Return to client ☐

Disposal: Lab disposal ☒

Initial Chemistry Upon Arrival @ Laboratory							SAMPLE INFORMATION					Toxicity Testing Requested			
Sample #	Temp °C	Dis. O ₂	pH	Alk. mg/L	Hard. mg/L	Cl- mg/L	Sample Identification	Sample Type C = Comp G = Grab	Sample Volume	Sample Date	Sample Time	Acute	Chronic	Sediment	Other
	4.0						DC-SED-13	C	1 GAL	4/4/07	11:45				
							OC-SED-19	C		4/3/07	14:48			X	
							OC-SED-07	C		4/3/07	09:30			X	
							DC-SED-01	C		4/2/07	11:00			X	
							DC-SED-03	C		4/2/07	10:59			X	

Samples were:

1. Collected by AAT personnel ☐
Client personnel ☒

2. Transported on ice? ☐
Yes ☒ No ☐

3. Received with in holding time? ☐
Yes ☒ No ☐

4. Sample matrix is: Liquid ☐ Sediment ☒
Soil ☐ Other ☐

CUSTODY INFORMATION									
Sample #	Relinquished by:	Received by:	Date	Time	Relinquished by:	Received for Lab:	Date	Time	Lab Use ISTN#
DC-SED-13	<u>[Signature]</u>	<u>FEDEX</u>	4/4/07	1700	<u>FEDEX</u>	<u>[Signature]</u>	04/05/07	0900	07282
DC-SED-19	<u>[Signature]</u>								07283
DC-SED-07	<u>[Signature]</u>								07284
DC-SED-01	<u>[Signature]</u>								07285
DC-SED-03	<u>[Signature]</u>								07286

Special Instructions: Dilution water collection date(s) N/A

Will ammonia be analyzed on these samples?

Will additional parameters be analyzed on these samples? Yes ☒ No ☐

AMERICAN AQUATIC TESTING, INC.

890 North Graham St.
ALLENTOWN, PA 18109
610 434 9015

Job #: 140-04-01

Client: SUTAC

Address: 1 South Wacker, 3TH Fl, Chicago, IL 60606

Phone #: 312-201-7788

Client Contact: Jack Brunner

CHAIN OF CUSTODY

Sample Return to client ☐
Disposal: Lab disposal ☒

Initial Chemistry Upon Arrival @ Laboratory							SAMPLE INFORMATION					Toxicity Testing Requested			
Sample #	Temp °C	Dis. O ₂	pH	Alk. mg/L	Hard. mg/L	Cl- mg/L	Sample Identification	Sample Type C = Comp G = Grab	Sample Volume	Sample Date	Sample Time	Acute	Chronic	Sediment	Other
	4.0						OC-SED-26	C	1 GAL	4/3/07	17:45				
	↓						DC-SED-05	C		4/3/07	09:16			X	
							OC-SED-05	C		4/2/07	13:45			X	
							OC-SED-14	C		4/3/07	13:30			X	
														X	

Samples were:

1. Collected by AAT personnel ☐ Client personnel ☒ 2. Transported on ice? Yes ☒ No ☐ 3. Received with in holding time? Yes ☒ No ☐ 4. Sample matrix is: Liquid ☐ Sediment ☒ Soil ☐ Other ☐

Relinquished by:		Received by:		Date		Time		Relinquished by:		Received for Lab:		Date		Time		Lab Use
OC-SED-26	<i>[Signature]</i>	FEDEX		4/4/07		1700		FEDEX	<i>[Signature]</i>			04/05/07		0900		07287
DC-SED-05	<i>[Signature]</i>															07288
DC-SED-05	<i>[Signature]</i>															07289
DC-SED-14	<i>[Signature]</i>															07290

Special Instructions: Dilution water collection date(s) N/A

Will ammonia be analyzed on these samples? ☐ Yes ☒ No

Will additional parameters be analyzed on these samples? ☐ Yes ☒ No

890 North Graham St.
ALLENTOWN, PA 18109
610 434 9015

Job #: 140-04-01

Client:

Address:

Phone #:

SULTRAC

Client Contact:

CHAIN OF CUSTODY

Jack Brunner

Sample	Return to client
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
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88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

Disposal: Lab disposal

[illegible]

Samples were:

1. Collected by AAT personnel
Client personnel

[]

2. Transported on ice?

☒

Yes ☒ No ☐

3. Received with in holding time?

Yes ☒ No ☐

Yes ☒ No ☐ 4. Sample matrix is:

Liquid ☐ Sediment ☒
Soil ☐ Other ☐

[illegible]

APPENDIX E
SEDIMENT VOLUME SUMMARY

**SEDIMENT VOLUME SUMMARY
DUCK AND OTTER CREEKS**

Duck Creek					
Exposure Area	Average thickness(ft)	Creek width(ft)	Length(ft)	Volume(ft3)	Volume (cubic yards)
DC-A	3.09	24.25	5,631	422,405	15,645
DC-B	2.14	24.00	4,385	224,950	8,331
DC-C	1.34	12.17	2,804	45,867	1,699
DC-D	0.93	13.75	4,710	60,175	2,229
DC-E	1.57	37,771 (pond area)		59,302	2,196
Approximate Total Volume				812,700	30,100
Otter Creek					
Exposure Area	Average thickness(ft)	Creek width(ft)	Length(ft)	Volume(ft3)	Volume (cubic yards)
OC-A	3.73	36.71	10,722	1,470,243	54,453
OC-B	1.50	20.40	4,963	151,866	5,625
OC-C	1.16	17.75	10,648	218,937	8,109
OC-D	0.65	12.30	6,188	49,629	1,838
OC-E	1.19	10.40	10,255	126,562	4,687
Approximate Total Volume				2,017,200	74,700



LEGEND

- DUCK AND OTTER CREEKS
- DUCK AND OTTER CREEKS WATERSHED
- BOAT LAUNCH
- ★ SAMPLE STAGING AREA
- SEDIMENT SAMPLE LOCATIONS**
- ▲ MASTER STATION
- ▲ INTERMEDIATE STATION

DUCK CREEK EXPOSURE AREAS

DC-A: MAUMEE RIVER TO CSX RAIL CROSSING
DC-B: CSX RAIL CROSSING TO YORK STREET
DC-C: YORK STREET TO CONSAUL STREET
DC-D: CONSAUL STREET TO HECKLINGER POND
DC-E: HECKLINGER POND

OTTER CREEK EXPOSURE AREAS

OC-A: LAKE ERIE TO MILLARD AVENUE BRIDGE
OC-B: MILLARD AVENUE BRIDGE TO CORDUROY ROAD
OC-C: CORDUROY ROAD TO NAVARRE AVENUE
OC-D: NAVARRE AVENUE TO BROWN ROAD
OC-E: BROWN ROAD TO TRACY ROAD

**DUCK AND OTTER CREEKS
SEDIMENT SAMPLING AND ANALYSIS**

**FIGURE 4
SITE LAYOUT AND PROPOSED
SEDIMENT SAMPLE LOCATIONS**

